Enciclopedia en Español de Maquinaria para Minas, Pagina 60

MAR 24 1917

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ENGINEERING AND MINING JOURNAL
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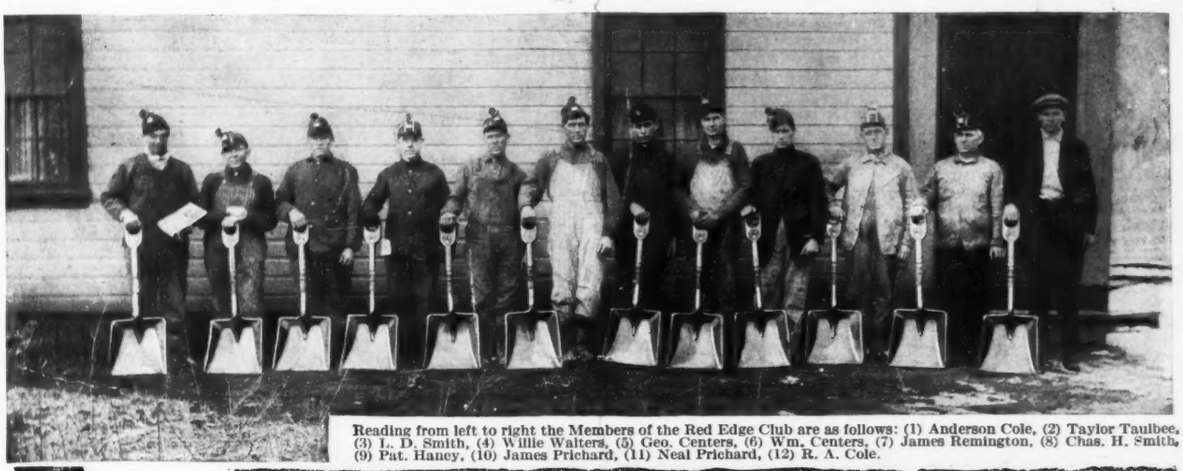
Engineering and Mining Journal

With which is consolidated Mining and Engineering World

Volume 103, No. 12
Issued Every Saturday
McGraw-Hill Publishing Co., Inc.

NEW YORK, MARCH 24, 1917

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page



Reading from left to right the Members of the Red Edge Club are as follows: (1) Anderson Cole, (2) Taylor Taulbee, (3) L. D. Smith, (4) Willie Walters, (5) Geo. Centers, (6) Wm. Centers, (7) James Remington, (8) Chas. H. Smith, (9) Pat. Haney, (10) James Prichard, (11) Neal Prichard, (12) R. A. Cole.

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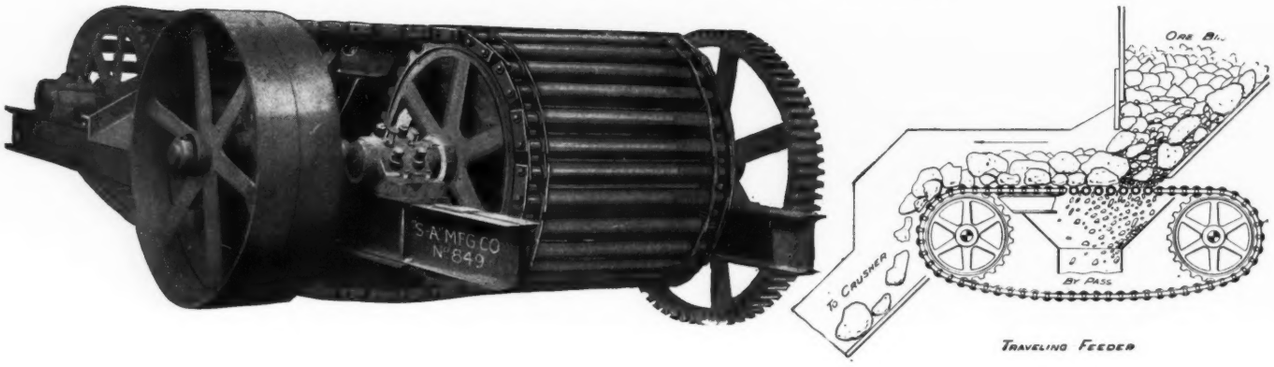

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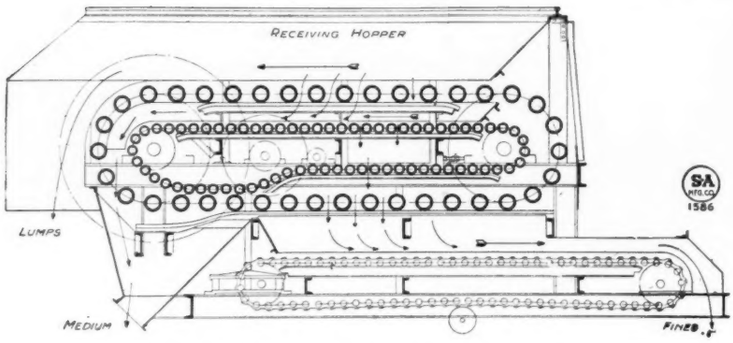

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Engineering and Mining Journal

VOLUME 103 MARCH 24, 1917 NUMBER 12

Unwatering Projects at Leadville

By Arthur J. Hoskin*

SYNOPSIS—Three unwatering projects have been undertaken in Leadville. One by the Downtown Mines Co., under Ex-Governor Jesse McDonald, is being conducted through the Penrose shaft. The project undertaken by the Leadville Unit of the United States Smelting, Refining and Mining Exploration Co. will accomplish the drainage of Fryer and Carbonate Hills through the Harvard shaft. The Empire Zinc Co. is unwatering a group of properties along Stray Horse Gulch through the Greenback shaft. The completion of these projects will lend great impetus to mining in Leadville.

A systematic campaign of unwatering old mines has been in progress at Leadville, Colo., for nearly two years. Undertakings of this sort in the old, well-worked sections were somewhat speculative, but they were predicated upon geological, mineralogical and historical premises that appeared to be sound.

Not much, if any, ore of the kinds mined during previous activities in these same properties was expected to be rendered immediately available by unwatering, but the men back of the projects had confidence enough in the properties to believe that, by solving the water problem through installations of up-to-date apparatus, they could anticipate two sources of revenue; namely, from the working of the zinc ores hitherto considered waste and from deeper development.

The hills within and immediately east of the City of Leadville were splendidly productive for decades. Large tonnages of lead, silver, gold, iron, manganese and copper ore were mined from the erratically distributed orebodies in the replacement or contact formations of Carbonate and Fryer Hills. Mining was discontinued about 10 years ago in most of these mines. Heavy flows of water encountered necessitated constant pumping at the numerous shafts, and the expenses incurred by the individual operators, coupled with the then prevailing low prices for the metals brought about a condition that led to the cessation of pumping and the consequent flooding of the mines.

Ex-Governor Jesse F. McDonald succeeded, after a year or more of negotiations, in rounding up practically all the mines that had been previously spoken of as in the "Downtown" district, and incorporated them as the Downtown Mines Co., which he has skillfully managed until success finally looks certain. The Leadville district recognizes the great significance of this project, and men who have backed the enterprise by putting capital into it showed their faith in Leadville's ability to "come back."

Despite the modern heavy machinery that was installed in the Penrose shaft for the purpose of draining this large group of downtown properties, the task has proved

SURFACE PLANT AT THE PENROSE SHAFT, WITH MT. MASSIVE IN THE DISTANCE

*Mining engineer, Box 526, Leadville, Colo.

much greater than was anticipated by even the most pessimistic critic prior to the undertaking. Instead of requiring only a few months to drain this ground, it actually took more than a year to lower the water sufficiently to install permanent pumping machinery at the bottom of the shaft, which is 874 ft. deep. Success seemed then attained when, in making slight excavations for setting the new pumps, a previously unsuspected watercourse was opened and the additional flow has kept the pumps working almost to capacity since the spring of 1916. The source of this flow proved a mystery, but from observations in old mines three miles or more to the east, it was suspected that the Penrose pump was draining several Iowa Gulch mines. This is substantiated by the flow subsiding in the distant mines with the lowering of water in the downtown mines. At the same time it has been shown that a rather strong flow enters the Penrose workings from the north.

Fig. 2 is a surface map of the eastern portion of Leadville and shows, by heavy line, the eastern boundary of the properties now controlled by the Downtown Mines Co. Among the claims included are many that were famous in the early days, among them being the Gray Eagle, Bon Air, Penrose, P. O. S., Wolcott, Midas, Augusta, Bison, Orion, Weldon, Alice and Otisito. The mines are adequately provided with railroad facilities; ore shipments can be made over the Denver & Rio Grande, Colorado Midland and Colorado & Southern railways. As fast as they can be reached, either by underground workings from the Penrose shaft or through the reopening of their own abandoned shafts, these mines promise to become scenes of renewed activity. Leasers are clamoring for opportunities. Already the Gray Eagle's shaft has been retimbered, a new headframe erected and a new hoisting plant installed. This mine was first operated by Eben Smith and David H. Moffatt, who mined large bodies of lead-silver ore. Similar improvements are in progress at the Bohn, Coronado and Wolcott shafts. The Penrose is already shipping two varieties of ore. Shipments of carbonate ore averaging 25% zinc are being made to Eastern reduction works, while other shipments of ore running about 26% metallic manganese and 30% metallic iron are being sent to the steel works of the Colorado Fuel and Iron Co. at Pueblo. This latter variety of ore runs about 0.034% phosphorus and less than 4% silica. Fig. 1 shows a composite plan of most of the openings that were made in this ground during the former operation in the palmy days of Leadville's career.

As these openings are on several levels, the workings are not so complex as they appear. A few of the drifts terminated without having reached ore. Large orebodies were mined, but at the same time, it must be remembered that most of the stoping was done in the upper levels and that development on the ground below may prove it just as profitable. Quantities of mineral that was formerly considered worthless rock are now known to be zinc ores, so that some of the pillars remaining between worked out blocks of ground that were originally purposely avoided are now reserves. They require only the reopening of such old workings to assure their early mining and marketing—as is being done in the Penrose. These reserves constitute one of the anticipated sources of revenue, while the ores that are presumed to exist in the hitherto unexplored deep portions of the hills (probably all of sulphide character) compose the other incentive to the unwatering.

At the Penrose shaft plant electric drive has been substituted for steam, current being received from the mains of the Colorado Power Co. The hoistroom contains a two-drum engine, provided with an electric motor of 175 hp., using current at 550 volts and running at 700 r.p.m. under full load. Adjoining the hoistroom are the shops. The shafthouse surrounds the collar of the three-compartment shaft and the headframe. The transformer house is of concrete and contains four transformers that receive current at 6600 volts and deliver it at 550 volts.

The machinery used in this project has been described before, so it will be sufficient to say that the pumps are two-stage centrifugal, direct-connected to General Elec-

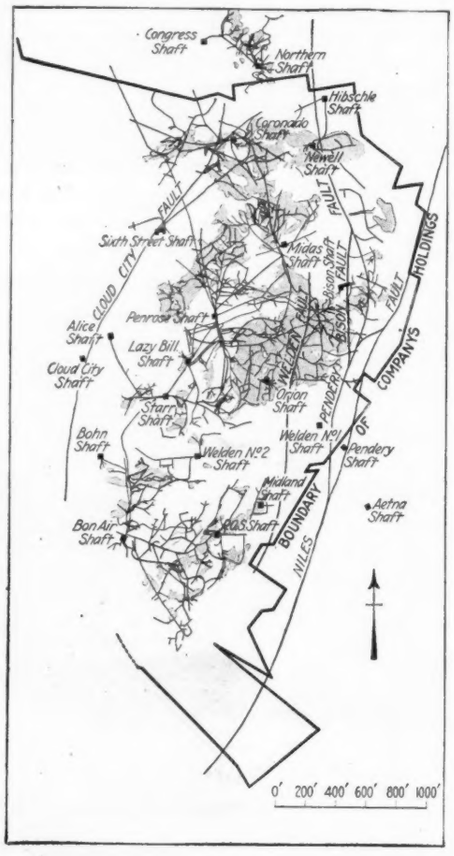


Fig. 1

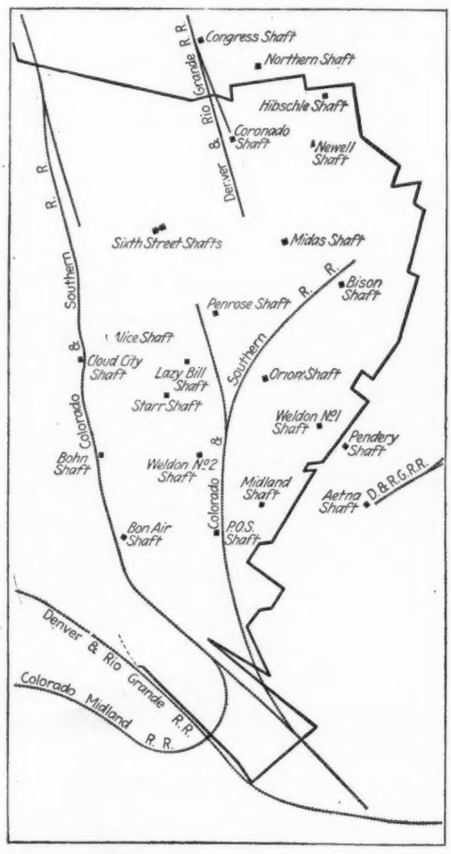


Fig. 2

FIGS. 1 AND 2. MAPS SHOWING THE UNDERGROUND WORKINGS AND SURFACE OPENINGS OF THE DOWNTOWN MINES CO.

tric 300-hp. induction motors running at 1810 r.p.m. The pumps were all furnished by the Providence Engineering Works. They were specially designed to hang in the compartments of the shaft, in which they could be hoisted and lowered the same as cages and operate in upright positions. When the surface of the water had been lowered to the 410-ft. point, a large station was cut and two relay pumps, exactly like the two sinkers except that they were set stationary, were installed and these were connected in series with the sinkers, which continued on downward. This equipment handled more than its guaranteed 2000 gal. per min. and for long periods was lifting as much as 2700 gal. per min. When the bottom level was finally drained, the sinkers were permanently set as station pumps. This unwatering equipment represented an investment of about $65,000.

The properties included in these holdings are credited with an aggregate production of about $12,000,000 as shown by smelters' settlements. The previous mining has been in the so-called first and second contacts. There is still the third contact to be explored, while it is improbable that all the shoots in the two upper contacts have been disclosed. This area has been proved to be heavily mineralized; it contains a large extent of virgin ground; it is ideally located for economical mining; and it has abundance of ores formerly avoided.

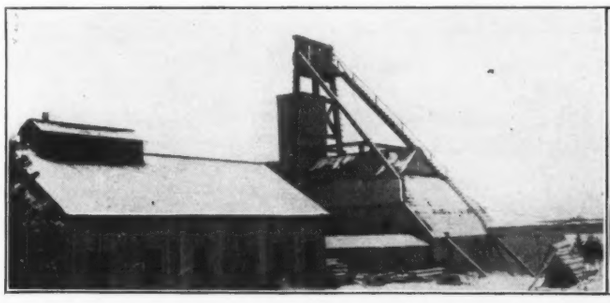
In addition to the Downtown Mines Co.'s project, the drainage of Fryer and Carbonate Hills has been done by the Leadville Unit of the United States Smelting, Refining and Mining Exploration Co. This company began its actual operations here a little more than a year ago, after it had spent months in securing long-time leases on 38 different mining properties. There were no purchases made. The ground secured lies in a rather compact area of about 200 acres, with maximum dimensions of 2000 by 4200 ft. Among these properties are such well-known old mines as the Fitzhugh, Cora Bell, Bangkok, Forepaugh, Tip Top, Quadrilateral, Jamie Lee, El Paso and a part of the Denver City.

These mines all lie either on Fryer Hill or just across Evans Gulch to the north on a southwest flank of Prospect Mountain that is called Canterbury Hill. Fryer Hill was one of the portions of the Leadville district that attained fame in pioneer days. There is no record of the gross production of these mines, but it is generally conceded that they have produced millions. Mining in this portion of the district practically ceased about a decade ago because of the great expense incurred by the numerous companies in combating the inflows of water, together with the seeming near exhaustion of orebodies in the proved zone or contact. Formerly, coöperation in drainage did not receive sufficiently serious attention to attain substantial results. It remained for a strong outside company with many interests scattered throughout the mining world to enter the field and to undertake a task that had hitherto been little more than a serious desire among residents of the district.

The company took these leases and started its expensive operations with the intention to drain the old workings, to sink deeper and to explore the white-limestone horizon in which there is strong reason to expect more orebodies such as have been proved in the lower zone in other parts of the district.

The management of this difficult project was given to Howard S. Lee, who has long been connected with the company's operations in other districts; his superintendent is E. A. Hamilton, and the mining engineers are Carl A. Allen and Douglas Platt. Owing to the unwieldy title possessed by this company, this particular project was styled its Leadville Unit, while popularly this name is still further abbreviated to the Unit.

Although the Harvard shaft is somewhat near the western boundaries of the holdings, it was selected as the center for drainage operation, its collar being upon a low part of the surface just north of Evans Gulch. At the time work was begun here, this site was thought also to be the best for the mouth of future mining operations. Accordingly, a most complete surface plant was erected. Among the buildings are a commodious shafthouse surrounding the collar of the three-compartment shaft, a shop, a hoisting and compressor building, a main office, an assay office and a warehouse.



SHOP AND SHAFTHOUSE AT THE HARVARD SHAFT

GENERAL VIEW OF FRYER HILL AND EVANS GULCH

The timbering in the Harvard shaft was found to be in splendid condition, while that in the Jamie Lee shaft—which was also seriously considered—was rotten and the shaft was about to cave. The first underground work was that of cutting a pump station in the Harvard shaft, above the water level, at a depth from the collar of 216 ft. In this station were placed two Krogh four-stage centrifugal pumps, each with one impeller removed, thus reducing its power consumption and likewise its efficiency. These pumps were found to lift 625 gal. per min. each to the surface at an efficiency of 60%.

Next a deep-well Byron-Jackson eight-stage turbine pump was lowered in the shaft and suspended from steel I-beams. This pump (sometimes called a "shoestring pump") extended downward into the water 190 ft. to the bottom of the shaft. It handled 1000 gal. per min., delivering its discharge to the suction of the relay or station pumps which, in turn, threw the water to the surface where it flowed into Evans Gulch. The arrangement worked well. The only difficulties experienced were with

débris in the shaft. There being no sump, it was necessary to maintain the foot of the pump close to the bottom of the shaft in order to drain the main level. Boulders, water-logged timbers and large quantities of mud and sharp sand all contributed to the troubles of the pumpmen. The impellers of the pumps wore rapidly because of the sand. When the water was lowered sufficiently for men to work in the bottom, or 407-ft. level, a concrete bulkhead was constructed to shut off a considerable flow which it was desired to hold back during the excavation and equipping of the permanent pump station.

The Harvard shaft is close to Evans Gulch, and the old workings pass beneath the stream. When the inflow of water did not abate, it was suspected that the mine was receiving a good portion of its water from the creek directly above. A 3 x 5-ft. flume, 1400 ft. long was therefore built in the channel of the gulch, starting at the city water company's dam. The lumber for this flume was surfaced and slip-tongued, about 60,000 ft. being required at a cost of approximately $2200. Within 48 hours after the water had been diverted into this flume, the mine water had been reduced fully 50%, and one pump was thereafter sufficient to keep the shaft drained. The deep-well pump was continued in commission until the permanent, large pump station was completed and equipped, when it was removed from the shaft. This station contains two Krogh and one Byron-Jackson horizontal, four-stage centrifugal pumps, each running at 1800 r.p.m. Their combined capacity pumping to the surface is 1700 gal. per min. At present only one pump is kept running at a time. The pumps have General Electric induction motors and all take their suction from a large square sump at one side of the station. After this area had been drained, the engineers and samplers spent several months systematically exploring the old workings, making careful surveys, taking many samples and devoting special study to the geology. As a result, the company now possesses a most complete set of mine and assay maps and detailed geological cross-sections. The old workings to the east of the Harvard are somewhat lower in elevation. There is about 100 ft. difference in elevation between the collar of the Harvard shaft and the collar of the Jamie Lee shaft on Fryer Hill, but the bottom of the latter shaft was about 23 ft. lower than the station at the Harvard. To accomplish drainage of the bottom workings in the eastern part of the area, it was decided to install a pumping equipment in the Jamie Lee shaft. It was first necessary to repair this two-compartment shaft, and this was accomplished by thoroughly lining the compartments with 3-in. cribbing. The deep-well pump previously used in the Harvard shaft was then shortened to 60 ft. in length, reduced from eight-stage to three-stage and lowered in this shaft. By a line of spiral-crimp pipe laid through old stopes the water was then delivered from the Jamie Lee territory toward the Harvard shaft.

At first this pipe line proved very leaky, approximately 200 gal. per min. being lost along it. It was impossible to secure tight joints because of the crooks in the line, but the trouble was easily overcome by the use of sawdust secured from mills that were ripping logs. The stringy, fibrous sawdust was fed to the suction of the deep-well pump and, becoming entangled at the points of leakage, it soon reduced the loss to less than 10 gal. per min., an effectiveness considered sufficient for this temporary installation. This pipe line was provided with relief valves of home-made construction for venting air pockets that accumulated in the high points.

The water pumped from these eastern workings was so full of mud and sand that it was not piped directly to the Harvard station, but was discharged into a settling tank that was built in an old stope. From this tank the water overflowed and made its way by gravity a short distance to the Harvard sump. As the level below the stopes containing the leaky pipe line drained toward the Jamie Lee shaft, a series of baffles was constructed along this level to prevent mud and sand from flowing back to that shaft.

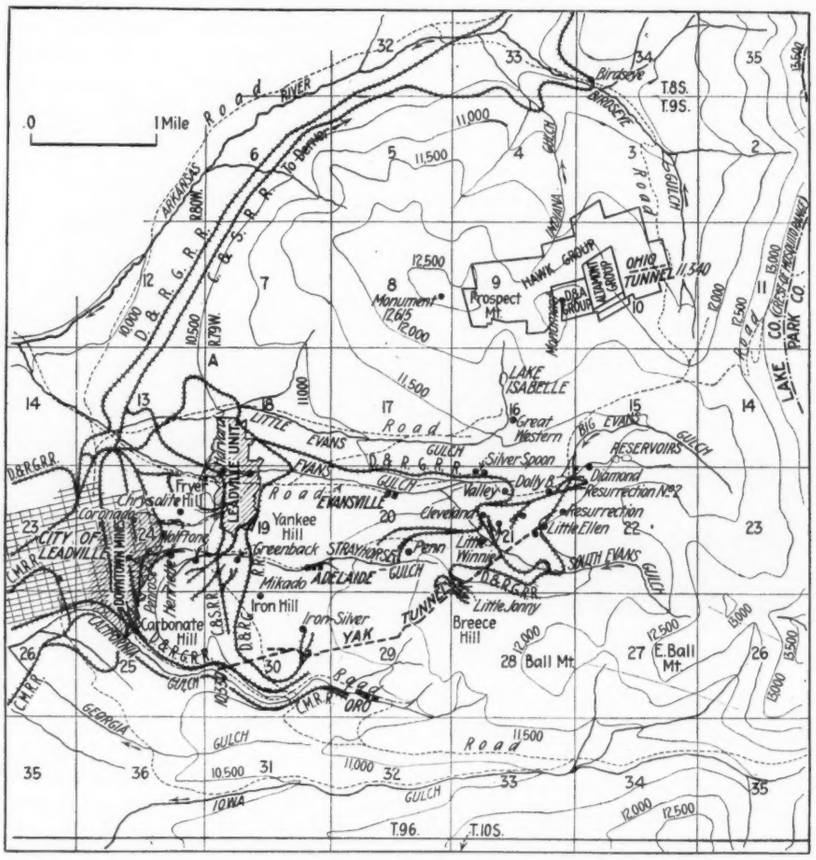


FIG. 3. TOPOGRAPHICAL MAP SHOWING MINE ENTRANCES IN THE VICINITY OF LEADVILLE

At present this pipe line proved very leaky, approximately 200 gal. per min. being lost along it. It was impossible to secure tight joints because of the crooks in the line, but the trouble was easily overcome by the use of sawdust secured from mills that were ripping logs. The stringy, fibrous sawdust was fed to the suction of the deep-well pump and, becoming entangled at the points of leakage, it soon reduced the loss to less than 10 gal. per min., an effectiveness considered sufficient for this temporary installation. This pipe line was provided with relief valves of home-made construction for venting air pockets that accumulated in the high points.

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Upon the completion of the investigations, it was evident that geological and mineralogical conditions in the vicinity of the Jamie Lee shaft were more promising than those near the Harvard shaft. By this time it was also concluded that the Fryer Hill site was better for mining operations in general and that the ground was drier. But, before all this had been determined, the permanent plant and the pumping station had been established at the Har-

yard. Therefore it was decided to make the Harvard plant the center for drainage and air compression, but to move all other surface activities to the Jamie Lee shaft. With this scheme finally settled upon, a series of old drifts was cleaned out for 1275 ft. connecting the two shafts. Along this level the permanent 8-in. pipe line conveys water from the eastern part of the property to the Harvard sump, replacing the line temporarily strung through the stopes.

A pump station has been equipped at the Jamie Lee shaft. This contains two single-stage Byron-Jackson horizontal units with 6-in. discharge, direct-connected to General Electric motors. The pumps have a combined capacity of 1600 gal. per min. working against a static head of 20 ft. plus a friction head amounting to 15 ft. This shaft is being sunk to explore the formations beneath the first contact, and water accumulating in the shaft is lifted to this station by an ordinary sinking pump.

Prospect of Deep Sinking

The depth to which the shaft will be sunk is not known. It is being done by contract for which 140 ft. has already been let. In all probability the shaft will be put down at least 300 ft. below its present level, but in any event it will be driven until it penetrates the Cambrian quartzite. Whereas the old portion of this shaft contains but two compartments, the new portion is being sunk and timbered for three compartments. The two hoisting compartments are each 4 x 5 ft. and the manway is 5-ft. square. Should the hopes of the company be realized at the new depths, the upper part of the shaft will be increased to three compartments. There is a possibility also that, should the orebodies extend toward the Harvard territory and beyond, a raise will be driven to connect with the Harvard shaft, which might thereafter become the opening for the area to the north and west or for practically all the company's holdings north of Evans Gulch.

The plant at the Harvard includes an Ingersoll-Rand Imperial type, two-stage compressor having cylinders of 21 in. and 12 in. by 16-in. stroke, rated at 1150 cu.ft. of free air per minute when running at 180 r.p.m. It is driven by short-belt connection from a 150-hp. General Electric motor. A new Laidlaw-Dunn-Gordon feather-valve type of compressor is being installed to provide more air that will be required by the expanding activities. This will be short-belted to a 250-hp. General Electric motor and, when running at 220 r.p.m., is expected to deliver 1440 cu.ft. of air per minute.

Hoisting at this shaft is done by a Denver Engineering Works electric hoist direct-connected to a General Electric I. T. C.-type 82-hp. motor. The rope pull is 5000 lb. when running at 400 ft. per min. The engine at the other shaft is a duplicate of this one, but it is to be operated at 600 ft. per minute.

Thus far, this project is in its constructive or prospective stage. Production was not anticipated early—unless possibly of zinc ore that might be found in the old workings. Up to Feb. 18, 1917, fifty carloads of ore had been shipped from the Tip Top shaft in this group, 15 carloads carrying some silver and occasionally high in zinc; the other lots were low-grade zinc ore. In this upper contact formation, the new work has developed four different exposures of ore. Shipments from these places have averaged about 20% zinc. Some curiosities in mineralization have been observed here. At some points a sheet of oxidized zinc ore will be found to be underlain by a straight zinc sulphide ore, and this in turn lies upon a zinc carbonate ore. Some investigation is already being made toward the local treatment of the ores that are expected to be developed in this large property.

The Empire Zinc Co.'s Project

Another pumping project has just been successfully concluded at the Greenback shaft (see Fig. 3). Although this mine is the property of a private individual who has no desire to sell, the use of this shaft as a drainage center was obtained by the Empire Zinc Co., which holds a group of properties along Stray Horse Gulch on Carbonate Hill in the vicinity of the Wolftone mine.

In this work a Layne-Bowler sinking pump was used steadily for several months. When the shaft was finally drained, a station was excavated at the 900-ft. point and permanent pumps were installed. These pumps have a capacity of 1200 gal. per min., but their duty has been gradually decreasing while the ground has been draining until at present they are handling only 500 gal. per minute.

Drainage of this shaft will prove a benefit not only to the Empire Zinc Co., but to the Wolftone and Iron-Silver companies, neighbors respectively on the west and south. The Iron-Silver Mining Co. is preparing to begin pumping operations of its own in its Mikado shaft. Among mines that will either start new operations or will be permitted to enlarge their present scope as a result of this pumping are the Robert Emmet, McCormick and the Greenback. These properties are well known for their records and are expected to outdo their earlier productions. When closed down because of the trouble with water, the Greenback was reported to have showings of ore aggregating $1,000,000.

By the middle of the summer of 1917, all these old properties that have been recently reclaimed should be scenes of most active mining, and the effect will be most beneficial not only for this district, but for the whole State of Colorado.

Consolidated Interstate-Callahan Mining Co.

The report of the Consolidated Interstate-Callahan Mining Co., Wallace, Idaho, for the last quarter of 1916 shows that 40,708 tons of ore was mined and 33,726 tons milled, the average contents being 24.75% zinc, 2.1 oz. silver and 6% lead. The total mill recovery was 81%, and on the basis of metals paid for, 78%. Total zinc in zinc crude and zinc concentrates shipped was 15,830,100 lb., and the total lead, 1,286,670 lb. Cost of mining per ton extracted was $4.735, and milling, $1.33 per ton.

Maximum production was maintained during the quarter, there having been shipped 16,424,704 lb. of crude zinc ore and concentrates. Mill recovery is somewhat lower than in the preceding quarter. This was caused by a lack of water for the mill, which condition has now been remedied.

One dividend was paid during the quarter, amounting to $1.50 per share, or a total of 697,485. All dividends paid to date amount to $11.50 per share, since Apr. 1. 1915, a total of $5,347,385.

Asbestos From Ontario

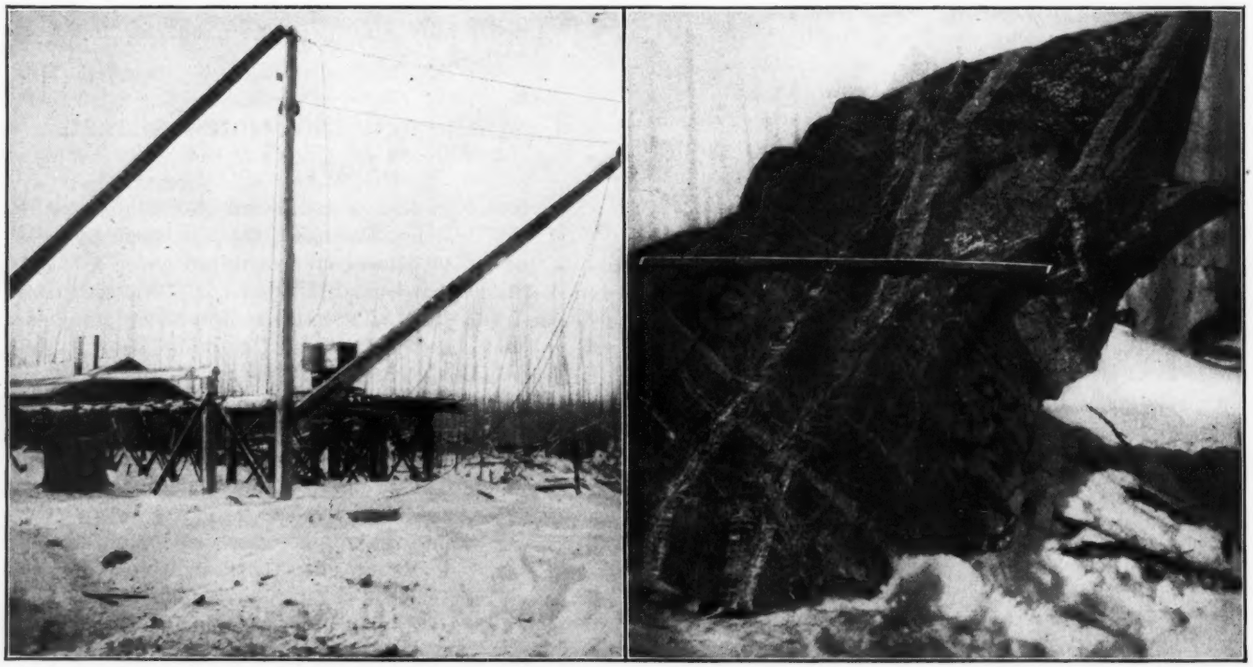
TORONTO CORRESPONDENCE

The high prices now being paid for crude asbestos—that is, hand-sorted long-fiber—has stimulated production in the Thetford district in Quebec and has also been the means of creating interest in hitherto unexploited areas.

Pre-war prices of No. 1 crude, fiber of 1-in. and over, was about $275 a ton, while No. 2 crude, being fiber from ½ to 1 in., sold at $135 a ton. Sales have been recently made from $1000 to $1200 a ton for No. 1 and $600 to $800 a ton for No. 2. While these are in a sense war prices, the production of crude during the last few years has fallen considerably below market requirements, so it is doubtful if prices will ever again fall as low as those existing before the war.

In November, 1916, two former operators in the Thetford district, D. M. Forbes and Edward Slade, took over a property in the serpentine areas of the Township of Deloro in the Porcupine gold district of Ontario and are now producing a good grade of asbestos fiber. In January the first asbestos produced in Ontario was shipped. Work is being carried on by hand, and the crude fiber is hand-cobbed. A small steam plant is being installed to do the drilling and hoisting. Recovery of crude has so far been 1% of the rock mined, as against an average recovery of 0.5% in the Thetford district. The proportion of No. 1 to No. 2 is 1 : 10. The accompanying views show interesting scenes in the Ontario asbestos field.

OPENCUT IN FORBES & SLADE ASBESTOS MINE AND FIRST SHIPMENT OF ASBESTOS FROM ONTARIO



SURFACE EQUIPMENT AND SORTING HOUSE AND A SAMPLE SHOWING ASBESTOS VEINS IN THE FORBES & SLADE MINE

Mining Laws of Brazil

By Henry Thomas*

SYNOPSIS—The mining laws of Brazil were revised in 1915 to give greater protection to holders of claims. There are some things to be desired however, but the government is ready to coöperate with investors or prospectors.

Prior to January, 1915, a satisfactory title to mining property in Brazil could be acquired only by the purchase of ground from the owner. When mineral was discovered upon public domain, the only procedure was to attempt to secure a concession from the state, or from the federal government at Rio de Janeiro if the property was situated in a district in which state government had not yet been organized. This was always a troublesome and tedious matter, involving acts of either state or federal congress, and all concessions were further complicated by the fact that they were only granted "as against the rights of third parties." In other words, after a concession was secured some private party could come in and upset the title by claiming private ownership to the lands in question. Great opportunities were thus opened to "bleed" mining companies, and the whole system was most unsatisfactory.

In the early part of 1915 a new mining law was enacted as an attempt to relieve this situation. This it has done to a great extent, but many of the laws are still far from clear. The proprietor of any land owns all mineral rights on the land. The words "on the land" are here inserted because the federal government at Rio de Janeiro holds title to all navigable waters. The word "navigable" is generally construed to mean any stream that can be traveled by a canoe at some time during the year. As the rise and fall of all waters in Brazil is considerable, this brings practically all rivers and streams under federal jurisdiction. Under these conditions the land bordering the stream may be purchased from an individual owner and still the stream will belong to the federal government. On the other hand, a concession may be obtained from the government for the stream, and conflict with the owner of the property on the banks is almost certain to eventuate, owing to the flexibility of the law governing placer deposits. This law gives the owner of a concession title to 15⅓ meters on each side of the river, the edge of the bank being the point to which the waters of the stream reach at their highest known flood level. Many of the streams widen from a tiny rivulet to widths of more than a mile, so the complications are obvious.

Under the existing law the discoverer of mineral on public domain must first secure what is known as a prospector's license. This is not general in its provisions, but applies to only one designated area. It is granted for a period of one year and is renewable for two further periods of six months each. Application for this license must be made personally to the *Servicio Geologico* in Rio de Janeiro. Therefore the discoverer must either go to Rio or furnish someone there with a power of attorney to act for him. The renewals must be made in the same way. The discoverer writes a short description of the ground that he desires to prospect and files this with his application. The cost is nominal, generally not exceeding $10. A receipt for this paper is given him, and the licence is considered as granted if no notice refusing it is published in the *Diario Official*, a government daily newspaper, within 30 days from the date of filing the claim, Sundays excluded. The amount of ground that may be taken up under this license is 100 hectares or 50 km. along the bed of any stream.

This prospecting license secured, the discoverer must explore the area granted him. No definite amount of work is mentioned. At some time within the two-year period, the sooner the better, he must send to the *Servicio Geologico* in Rio a complete survey of the ground in question, with maps covering the geographical, topographical and geological features, together with samples of both ore and country rock and all possible information concerning the geological conditions of the district. At the same time he must make application for his concession, the area given being the same as in the prospecting license. The law sets no limit upon the number of tracts for which license or concession may be applied for by the same person, but requires that the law be complied with for each tract separately from any other area applied for, whether they are contiguous or not. The concession must be again applied for in Rio de Janeiro, either personally or by power of attorney. If done personally, the costs average about $100; if done through an attorney, about $500. Upon the registering of this application a notice of it is published in the *Diario Official* for a period of 60 days and also in the principal newspapers of the district in which the property is situated. If no objection is made during this period by anyone who has a valid title to the ground asked for, a concession is granted for a period of 30 yr., which may, at the discretion of the government, be extended.

Tax To Cover Cost of Government Examination

The owner of this concession must pay to the federal treasury, every three months in advance, a tax which cannot exceed a total of 12 *contos* per year, which, at the prevailing rates of exchange of 1916, is approximately $3000. The amount of this tax is based upon the cost of an examination of the property by a government inspector and is largely governed by the distance of the mine from Rio de Janeiro. If, for reasons beyond the control of the owner of the concession, work cannot be carried on continuously, the tax may be remitted at the discretion of the inspector for the period during which the property is inactive.

A prospecting license must be granted before a concession can be applied for. A foreigner as an individual can secure both license and concession, but a foreign company must be legalized—a process which takes about three months and costs about $500—before it can take title to any property.

The following metals and minerals may be acquired under these laws: Gold, silver, platinum, mercury, copper, lead, zinc, cobalt, nickel, bismuth, manganese, molybdenum, antimony, arsenic, tin, glucium, other un-

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specified rare minerals, graphite, anthracite and lignite coal, mineral oils, sulphur, diamonds and precious stones. The title to any other mineral substance *in situ* is vested in the owner of the soil.

A further clause states that all metal-bearing or gem-bearing sands in the beds of rivers belong to the owner of the soil, but as the owner is in this instance the federal government, as explained, all alluvial deposits where there is any flow of water at all at any season of the year are considered as open for location irrespective of the owners of the land bordering the stream.

The law provides for the settlement of conflicts between the rights of the discoverer and the owner of adjoining ground, going into these matters at some length. As a six weeks' journey is often necessary for the interested parties to reach the courts and as the witnesses are generally numerous and the cost of transportation very heavy and as the action of the courts is very slow, the settlement of these disputes by law is almost impossible.

To acquire a valid title to mining property in Brazil the owner of the soil, if there is one, should first be taken into consideration. The geographical situation of the property should be determined independently of any local information, which is unreliable. This point having been settled, a search should be made of the records at either the state capital or in Rio de Janeiro. Duplicates of all records in Brazil are kept in Rio. If an owner is found whose claims may conflict, it is wise to consider him and purchase any interest he may have or may think he has, as the good-will of the residents of the district is essential to success even if their claims are not strictly legal, as for reasons stated, recourse to the courts is almost impossible, particularly in any of the outlying districts. This statement applies especially to any claims in stream beds, because if the owners of the banks are not conciliated, trouble is liable to follow. This is not generally expensive, as the natives care nothing for mineral and would never work it themselves. If an undoubted owner of the soil is found, a government concession is not necessary for a lode claim, but great care must be exercised to see that all relations of the owner are taken into consideration when payments are made, or some distant relative may appear on the scene later on and contest the title. Where placer ground in river beds is to be acquired, both the owner and the government should always be considered. If this is done carefully, full personal investigation being made of all details, good title can be secured without trouble.

The export duties of the different states vary, but none of them are excessive. A transport tax is assessed in some states on mineral passing through to the coast. This is also small and is generally refunded upon production at port of receipts for export duties paid in the state from which the mineral came.

The *Servicio Geologico,* in Rio de Janeiro, which is at present under the Ministry of Agriculture, is greatly handicapped by the general lack of interest in its work, as evidenced by the meager appropriations placed at its disposal. Its officials are most courteous and anxious to assist in the development of mining. They will do everything possible to help the investor or prospector. The mineral resources of this great area are being slowly developed, and the next few years should show a marked change for the better in the facilities extended by the govenment to the prospector.

Foreign Trade in Lead and Zinc

Imports of lead and zinc during January, 1917, are reported by the Department of Commerce as follows:

Articles and Countries	Contents, Lb.
Lead Ore:	
England	182
Canada	3,339,677
Mexico	2,774,643
Peru	29,210
	6,143,712
Lead in Base Bullion and Bullion:	
Mexico	1,894,156
Peru	24,850
	1,919,006
Lead, Pigs, Bars and Old:	
Mexico	661,328
Canada	184,591
Barbados	1,000
Panama	9,546
Japan	500
	856,965

The actual tonnage of lead ore imported in January was 5774. The imports of zinc ore amounted to 21,189 tons in January. The countries of origin and the metal content were as follows:

Countries:	Contents, Lb.
Canada	1,613,000
Spain	3,163,560
Mexico	8,527,999
French Africa	1,245,000
	14,549,559

Zinc in blocks, pigs, etc., was imported as follows (in pounds):

Canada	50
Panama	3,106
Cuba	26,367
Guatemala	888
Costa Rica	423
England	600
	31,434

Imports of zinc dust from Japan amounted to 44,012 lb.

Exports of lead and zinc were as follows (in pounds):

Lead, Pig, Bars, etc.:	
Produced from domestic ore	16,189,417
Produced from foreign ore	1,282,263
Zinc, Pigs, Bars, etc.:	
Produced from domestic ore	29,156,436
Produced from foreign ore	5,301,222
Zinc, plates and sheets	1,546,149

Nevada Consolidated Copper Co.

The report of the Nevada Consolidated Copper Co., Ely, Nev., for the last quarter of 1916 shows production of 22,898,228 lb. of copper; 8,676,327 lb. in October, 7,047,486 lb. in November and 7,174,415 lb. in December. During the quarter 979,329 dry tons of Nevada consolidated ore, averaging 1.63% copper, was milled. Of this, 79% came from the pits and 21% from underground workings. In addition, 11,351 dry tons of Giroux Consolidated Mines Co. ore was milled.

Cost of copper produced, including Steptoe plant depreciation and all charges except ore extinguishment, and after crediting all miscellaneous earnings, was 9.2c. per lb. Profits are based on a copper price of 28.408c. per lb. for the quarter. No copper available for delivery remained unsold.

The surplus for the quarter was $1,526,841, after payment on Dec. 30 of the 28th dividend of 50c. per share and extra dividend No. 7 of $1 per share, amounting to $2,999,185.50. There was set aside $166,592 for plant and equipment depreciation and $97,652 for ore extinguishment, leaving a net credit to earned surplus for the quarter of $1,262,597, and a balance of $12,353,643 in earned surplus.

The Dairy Farm Mine, California

By J. E. Harding*

SYNOPSIS—An operating mine in the California copper belt is described. Shrinkage stoping was employed until it became inapplicable owing to the inclination of the vein. Caving was then used to complete the extraction, effecting the recovery of 12,000 tons that would otherwise have been lost.

Although the Placer County, California, copperbelt extends for about 40 mi. in length and 2 mi. in width, only one mine of any size has ever been developed upon it, this being the Dairy Farm mine, operated by the Vantrent Mining Co. under a tonnage contract. The operating company has been at work on the basic ore of the mine since January, 1915, and has maintained a monthly production of about 11,500 tons, making it one of the six largest in the state. The mine is on the Bear River, 38 mi. from Sacramento and 9 mi. from the station of Sheridan on the Shasta route of the Southern Pacific R.R., with which the mine is connected by a narrow-gage line.

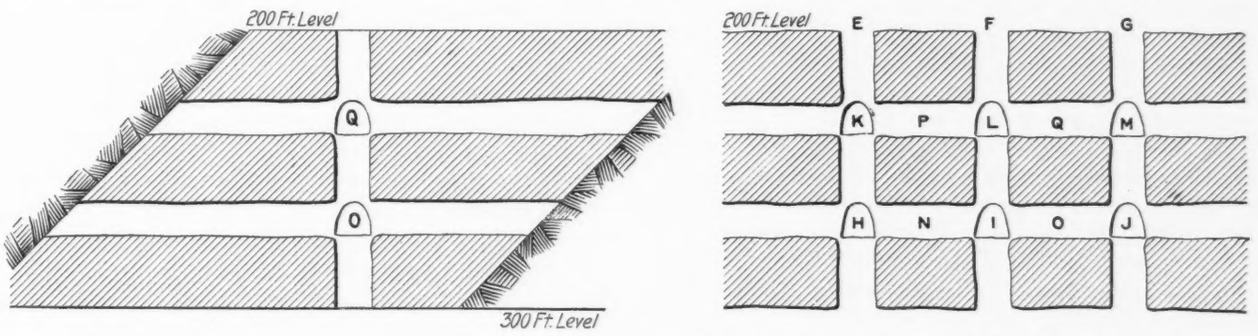
The orebody, consisting of a lenticular deposit of highly concentrated pyrite carrying a small percentage of copper and small quantities of gold and silver, is irregularly elliptical in shape, with the major axis lying slightly north of west and dipping to the east at an angle of from 45 to 65 deg. The extreme length of the workable deposit is 600 ft., with a maximum width of 90 ft. On both the north and south ends the ore diminishes in width to narrow stringers and pinches out altogether.

The mine is developed by an incline shaft in the foot wall dipping at 62 deg., with levels run every 120 ft. on the incline. Hoisting is done with a 140-hp. electric hoist and two skips of 2½ tons' capacity running in counterbalance. The skips are tended by two men underground and dump automatically.

The main crosscut had been driven from the shaft straight across the vein, and it was determined to make the attack upon the orebody on each level from this crosscut. The new development work consisted in driving two new drifts 8x8 ft. in the clear, both north and south on the vein, the first following the foot wall as nearly as possible and the second parallel to the first, carrying a 15-ft. pillar between the two. When the width of the orebody reaches 25 ft. or over, it is deemed advisable to stope from two drifts and when less than that width, to stope from a single drift run along the foot wall only.

Whenever drifting is done, a bonus system is in force to expedite the work. From the mine crew the most efficient men are selected, both machinemen and muckers, and paid a bonus of 50c. a day each, above regular wages. Each shift crew consists of two machinemen and two muckers. The machines used are the small-sized water Leyners, and the drifts are broken with 16 holes to the round, 4 holes high and 4 wide, the two center vertical rows being drilled one by each machine in such a way that a V-cut is formed running from the floor to the roof of the drift. The side holes are drilled straight in along the wall of the drift. As soon as they come on shift, the machinemen make a set-up with a crossbar above the muck-pile and drill the 12 holes forming the upper part of the round. By the time this drilling is done, the muckers generally have the greater part of the muck out of the way, enabling the machinemen to make the lower set-up and drill the lifters with little delay. Proceeding in this way, no trouble is experienced in drilling and shooting a 5-ft. round each shift.

It was found necessary to drive several raises for development and ventilation purposes, and in doing this work a unique condition developed. Generally it has been found that such work can be done by contract faster and cheaper than on company time. The opposite, however, has proved true here. The first two raises were driven by contract, the company furnishing everything but the labor for drilling and timbering. The contractors in both cases had a relative or friend who needed a job and a tendency developed to do the poorest work that the foreman would stand for. On acount of this the contract system was abandoned and such work has since been done with the men on the bonus system, the same as in the drifts. This method has been found to be more satisfactory from all viewpoints. The work goes ahead faster, better and cheaper. The accompanying comparison is interesting. Raises Nos. 1 and 2 were driven on contract and No. 3 on company time, the two former being carried by a stull and lagging division between manway and rock chute and the latter with the manway square-set all the way. The figures merely show the cost per foot driven and do not indicate the better grade of work.



CROSS-SECTION AND LONGITUDINAL SECTION OF STOPE, SHOWING DEVELOPMENT WORK PREPARATORY TO THE ELECTRIC BLAST

*Care of American Smelting and Refining Co., Caldera, Atacama, Chile.

The stopes are driven across the vein and vary in length from 40 to 70 ft., depending on the thickness of the formation. Generally pillars about 8 ft. thick are left between stopes. Work is begun from the levels to bring the stopes into production as soon as the drifts are run, and is carried on under one stope while the drifts are going along under the next. To avoid holding up transportation in drifts and stopping work in the headings while stope work is in progress, crosscuts are run between the drifts under the pillars separating the stopes, and track and switches placed in such a way that when one drift is closed to traffic by the stope-development work, either one or both of the development drifts may still be accessible.

RAISING COSTS PER FOOT

	Raise No. 1	Raise No. 2	Raise No. 3
Machinemen and timbermen	$4.023	$3.263	$3.185
Muckers and carmen	.940	1.187	.870
Miscellaneous labor	.092	.180	.126
Liability insurance	.157	.324	.296
Timber	1.106	.996	1.119
Explosives	1.282	.981	1.152
Power	.212	.187	.216
Candles	.110	.101	.091
Supervision	.155	.089	.102
Total cost per foot	$8.077	$7.308	$7.157

Development of a Shrinkage Stope

The first work in these drifts on the stope development is to lay off the portions which later act as pillars between chutes to support the stope. These portions are timbered solidly with 10 x 10-in. drift sets and the back lagged over solidly with pole lagging, the entire members being blocked down with all the care possible, leaving the places in the drifts where the chutes are later to be built entirely untimbered.

As soon as the pillars are timbered, raises are driven. These raises are carried up about 10 ft., which is generally accomplished in two rounds with a stoping machine, to what later becomes the stoping floor. Owing to the extremely friable nature of the ore, many experiments with the spacing of these chute raises have been tried. It has been found that placing them 6 ft. apart, while affording convenient drawing when the stope is being carried up, causes great difficulty in holding the pillars between chutes, as they become badly shattered by the blasting in the raises while being driven. Later practice caused them to be spaced farther apart to leave a pillar 8 ft. long between them. In diagonally opposite corners of the stope manways are carried up for ingress and egress. The manways are carried beside the corner chutes without any piller between.

This work is carried on in a regular sequence of operations. First, a raise is shot out at the corner of the stope, of a sufficient length for both a chute raise and a manway, the muck cleared away, the chute constructed and the manway carried up one set. Thus each chute raise is attacked in order, the men keeping continually at the same work. Efforts are made to keep the machinemen and muckers ahead of the timbermen and chute builders so that no one gang interferes with any other, causing delay. When the first manway and chute are completed, the work of cutting out the stope floor begins. A crew of two men on each shift, with Leyner machines, starts at the manway and cuts out a slice to a height of about 8 ft., connecting up and belling out each chute raise, leaving the stope ready for the operation of stoping machines. Generally, timbering the level, running the chute raises, building the chutes and cutting out the stope-floor slice are finished within a day or so of each other. Then the stope is carried up according to the usual practice in the shrinkage stope method of mining.

If the size of the stope warrants it, four stoping machines are put in and the work is carried on in regular cycles as far as possible. Drilling is started and carried on until the whole stope back, including the ground over the manways, is drilled, holes being put in to a depth of from 6 to 8 ft., forming a V-cut either crosswise or lengthwise, whichever seems desirable or sometimes necessary owing to the lay of the ore lenses. As soon as the drilling of the stope back is finished, one manway is bulkheaded over solidly with 6x8-in. timber, the V-cut and all the holes in one half of the stope, including those over the bulkheaded manway, are shot with fuse and cap. The number of holes shot in this way varies from 50 to 200 according to the size of the stope. When a large number of holes are to be shot, sufficient men are called from other parts of the mine to aid in spitting, and no difficulty has ever been found in spitting and getting away in safety, although one round of 356 holes was fired using only 10-ft. fuses. At first, difficulty was caused by the holes going in the wrong order and cutting out or causing others to miss. These troubles have been obviated by cutting fuses of the same length very carefully and having enough men present to spit a row of holes entirely across the stope at the same time. Acetylene lamps are used to light the fuses. Before spitting, the fuses are all split and the men take their designated positions. At the word "Go" each man lights a fuse and then another, as the boss counts off each second. This method of spitting has proved very successful, the holes going in such perfect rotation that rounds of 150 holes are frequently counted for reports with not over 3% short. In the regular shooting, Hercules E.L.F. ammonia dynamite, 1⅛-in. size, 40% strength, is used. The cut holes are loaded four sticks and the remainder three sticks. This method of loading and shooting has never failed to break the round and is satisfactory.

Blasting is always done by the night shift when coming off, to allow time for the smoke and gas to clear out. The next shift entering the stope bars down the loose ground, clears the manway while the chutes are being drawn from below, plugs whatever large blocks of ore are in sight in the muck-pile and prepares the stope for the next oncoming shift to load and blast the holes remaining in the stope, which is done. The next shift clears the stope as before and prepares to start drilling, thus completing the cycle. This cycle generally consumes four days of two shifts each, but sometimes difficulties are encountered which lengthen the cycle.

Difficulties in Shrinkage Stoping

While drilling in the stope is in progress, timbermen carry the manways up one or two sets as necessary to bring them to the stope back and make the bulkhead easy to clean after the stope is shot. These manways are carried up offset from the stope into the pillars by their own width, thus giving them protection on three sides by solid rock. The side toward the stope is protected by 3-in. lagging. The timber used for the manways is 8x8-in. framed and put up in regular shaft-set fashion with 4½-ft. posts and wall plates of such length that the inside of the compartment is 4x4 ft. in the clear. The set is lagged on all sides and blocked on all corners to the solid wall

rock. No manway has ever given way, and in nearly two years only three wall plates have been broken by blasting.

This method of carrying up a stope always starts off well, but often runs into difficulties before the stope arrives at the level above. The overlay of the orebody owing to its dip carries the back of the stope far away laterally from a vertical plane through the chutes on the level below. Of course it will be seen that the chutes pull vertically so that when the stope is up from 50 to 60 ft. all the drawing, even from the foot-wall chutes only, lowers the muck on the hanging-wall side of the stope. If the stope is unduly pulled, the hanging side not only becomes too low to drill from the muck, but also very dangerous. Too much mucking has to be done from the foot wall to make room to drill from the muck. This shoveling in the stope is slow and tedious as well as expensive and slows up the work in the stope to a marked degree. However, if the ore does not lie too flat or the hanging wall become too dangerous, the stopes are carried through on the straight shrinkage system throughout.

In one stope insurmountable obstacles were encountered. The dip fell to nearly 45 deg., and the hanging wall became very loose and dangerous so that the stope was stopped at a height of 56 ft. above the level. A different method had to be employed, or about 12,000 tons of ore still remaining from the back of the stope to the level above had to be left. To mine this a method of vertical block caving was worked out.

Details of Special Stoping Method

The raises *E, F* and *G,* in the illustration, were run from the center line of the back of the stope to the level above. Then the crosscuts *H, I, J, K, L* and *M* were run from hanging wall to foot wall to subdivide the block of ground vertically into three equal and smaller blocks. Then the junctions of the raises and crosscuts were connected by the drifts *N, O, P* and *Q*. The intention in the placing of these workings was to render it possible to drill practically the whole block of ground from the various raises, drifts and crosscuts as well as from the back of the stope and distribute powder in drill holes in such a way that the rock would be broken fine enough to pass the chutes at the bottom of the stope.

While the drilling of the block was in progress, a blasting expert was consulted, who advised blasting the upper tier of crosscuts by the pothole method, which was done. The potholes were merely offsets at the ends and centers of the crosscuts, the load for each pothole being from 8 to 16 boxes of from 40 to 60% powder, for which work 52 boxes were used in all. The lower tier of crosscuts was drilled on both sides with a Leyner machine and the back of the stope drilled to a depth of 10 ft. with stoping machines. Then all the holes and potholes were loaded and blasted by electricity with a total of 456 electric blasts, using altogether a few boxes short of four tons of powder. Instantaneous caps were used in all cases and current taken from a 440-v. 60-amp. circuit. No damage was done to any other part of the mine by the blast.

While no entrance to the zone of the blast has been possible since it was shot, more than the calculated tonnage of ore has been drawn out of the chutes below, from which the work is considered to have been successful. In drawing off the ore the rock appeared at the chutes, broken to various sizes from as fine as that produced from the regular rounds to pieces as large as a grand piano.

The problem of making such large rocks pass through the chutes was easily solved and causes no more trouble. A man is stationed on each level with a stoping drill and air connections so that he can reach whatever chute may hang up. When a hang-up happens, this man either drills and blasts or bulldozes whatever large rocks appear. Often the hang-up happens 10 ft. or more above the level of the chute mouth. For working under these conditions drills up to 14 ft. in length are kept handy, which generally reach the offending rock without trouble. When bulldozing, strips of 1-in. board are kept on the level at all times and the powder is tied to the end of one of these and placed in position. The object of this is to enable the chute blaster to work from the outside of the chute and never have to enter below the hang-up, where he may be crushed in case the rock falls. So far there have been no severe injuries in this work.

When the rock happened to be running large, the chutes were blasted every two or three cars, and this constant blasting produced unlooked-for results. When a high hang-up is blasted, of course the whole stope settles from top to bottom above the chute, the movement taking place in the shape of an inverted cone with the apex at the chute. Thus the hammering effect in the course of time crushed the already shattered pillars, and the timber in the drift began to give way. It finally became necessary to solid-set the drift and replace a large amount of broken timber. Guided by this experience, the chutes have since been placed farther apart, leaving larger and stronger pillars between, which have been able to support the stope and save the drift timber below. At present a pillar length of from 8 to 10 ft., according to the hardness of the ground is maintained.

Working along in this fashion, a rather creditable production per man-shift has been attained. In selecting a representative period for three months in which the breaking, hoisting and tramming have run along well together, the results given here are shown. For the months of June, July and August, 1915, the production for every man who worked below the collar of the shaft, including bosses, was, respectively, 7.20, 7.22, and 10.18 tons of ore hoisted per man-shift, from which should be deducted the small percentage of waste removed on top by the sorting crew. Since that time the production per man-shift has been increased and the costs lowered. Months could be selected during 1916 when the production ran between 13 and 14 tons per man-shift, but these would be when the tramming and hoisting was far in excess of the breaking and therefore not representative.

Labor Conditions During Operation

Owing to the situation of the mine, an abundant supply of labor is at all times available. As in all places, good men are scarce. At different times every nation and race of Europe has been represented on the payroll, as well as all countries of North America and many of South America. A high state of efficiency is required of the employees and any who cannot attain the desired standard are eliminated. Ninety feet of holes with the 16 V-type Waugh drill is regarded as the minimum, and the drilling of men who are considered good enough to hold a job runs from that to 130 ft. per shift. On the small-type Leyners not less than 65 ft. of holes per shift is required and efficient men often go as high as 100 ft. per shift. This, of course, applies when the men have

good conditions under which to work. In cases where a man has to spend time at work other than drilling or is delayed for some other legitimate reason, no particular amount of work is required.

The cars used in drawing from the chutes are of 20 cu.ft. capacity and carry, when full, from 2800 to 3000 lb. of ore. Two men work on one car. For this work the mine has been fortunate in generally having a large percentage of Herzegovinians and Servians, who are generally large and powerful men as well as willing to work. Sometimes pairs of Italians or Spaniards develop into good carmen, but the first-mentioned by all odds make the best trammers. The average run per pair of men is from 50 to 60 cars, or from 125 to 175 tons per shift. The record for a single day's run by two men is 100 cars, or 250 tons. The amount handled by any two men is governed largely by the length of haul and the size of the rock to be taken out of the chute.

Figured on a basis of tonnage per man-shift, the production of the Dairy Farm mine compares favorably with that of almost any mine in the world. The efficiency of the underground supervision is largely responsible for the rather remarkable work, although it must be remembered that the large tonnage produced is materially helped by the fact that the specific gravity of the rock either in place or broken runs about 40% higher than that usually encountered in mines.

The Wood Molybdenite Mine Near Quyon, Quebec*

The recent demand for molybdenite has greatly stimulated prospecting for that mineral in all accessible localities where it is at all likely to be found. From the outset the well-known varieties of minerals in that district have attracted attention to that part of the Ottawa valley immediately west of the City of Ottawa. Numerous discoveries have been made which vary in importance from mere mineral occurrences to deposits which have already given considerable production. The most important deposit yet proven is that known as the Wood mine, near the village of Quyon, on the north shore of the Ottawa River, about 33 miles west of Ottawa City, in the County of Pontiac, Quebec.

Work was begun in March, 1916, and production for the year is stated to have been somewhat in excess of 5500 tons of ore averaging 2% of molybdenite. All molybdenite ore produced in Canada is bought at the Department of Mines, Ottawa, for the imperial government at a rate of $1 per lb. for the amount actually recovered in concentration. The recovery is said to be 75% to 80% for ores carrying as low as 1% of molybdenite.

Four pits disclosing ore have been opened on the Quyon property. Three of these are near together and may yet prove to be practically in one body for working purposes, while the fourth pit (No. 2) is a quarter of a mile distant from the others. Pit No. 1, from which the principal part of the production has thus far been obtained, is an opencut 50 x 115 ft. which has been carried downward from a nearly level surface to a depth of about 30 ft. Machine drills are used, and hoisting is done by means of boom derricks. Steam power is used, the water being pumped a distance of 1¼ miles. There is ample water power five or six miles distant, the early development of which may be expected.

Hand sorting is done in the pit and on the surface, but the total amount of waste rock is small, apparently little more than 10%. After trial shipments had been made to the laboratory of the Wood Ore Testing Co. at Denver, the ore was principally sent to the concentrating plant of the Mines Branch of the Department of Mines at Ottawa. In shipment the ore is hauled by teams from the mine to Quyon station on the Waltham branch of the Canadian Pacific Ry., a distance of three miles over an average country highway. The hauling is done by contract, generally by farmers from the neighborhood. The ore is shipped without crushing and may be in blocks up to any size that can be handled by two men.

A concentrating mill capable of treating 60 tons of ore in 24 hours has recently been completed at the mine and a second concentrator of 150 tons' capacity is being built in the City of Hull, 35 miles distant, by the owners of the mine. The essential equipment of each mill consists of crushers, rotary driers and ball mills, together with a Wood flotation plant designed and patented by Henry E. Wood, of Denver, one of the owners. Commodious quarters for the men, well lighted and furnished, are a noteworthy feature of surface equipment of the mine. Exclusive of the teamsters who work by contract, about 130 men are at present employed in mining and construction.

At present little can be said definitely of the nature of the deposit. The country is one of low relief, much of it covered by drift, and the geological structure has not yet been worked out in detail. No diamond drilling has been done nor any trial sinking below the level of the actual workings.

The country rock is a reddish gneissoid granite of a type common to this part of the Laurentian system. The strike of the gneiss is about east and west. In one case, pit No. 2, the ore appears to be in a band of pegmatite which cuts across the gneiss in a northerly direction. At the other pits it may have had a similar origin; but the appearance in the field is suggestive of a rock of somewhat different composition, such as might have been inclosed in the intrusion of the granite gneiss. Detailed field and microscopic study will doubtless determine this definitely. It is, of course, a question of much importance both in its bearing on the probable depth of this deposit and as a clue to where others may be found.

Pyrite seems to be constantly present with the ore and in some places is nearly equal in amount to the molybdenite. No other sulphides are noticeable, but fluorite is common. While there are exceedingly rich pockets of ore, large crystals of molybdenite are not common. The ore is principally finely disseminated in flakes of half an inch or less in size at pit No. 1, while at pit No. 3 the average size of flake is probably less than 0.1 in. in ore of a very satisfactory grade.

*Paper read before Canadian Mining Institute, March, 1917, by John A. Dresser, consulting engineer and geologist, Montreal.

The Mineral Production of Algeria in 1916 was considerably larger than in the preceding year, according to statistics just published by "Echo des Mines." The output reported for the two years follows, with the 1915 figures in parentheses: Phosphate rock, 380,211 (225,871) metric tons; iron ore, 938,684 (818,705); copper ore, 1098 (nil); lead ore, 23,731 (15,046); zinc ore, 28,973 (16,796); antimony ore, 28,473 (9022); quicksilver, 31.6 tons. With the exception of the lead ore and the quicksilver, only a small proportion of these mineral products was utilized in France.

Managers of Metallurgical Plants in New York and Vicinity

H. H. STOUT
Nichols Copper Co., Laurel Hill, L. I.

R. W. DEACON
United States Metals Refining Co., Chrome, N. J.

H. H. ALEXANDER
American Smelting and Refining Co., Maurer, N. J.

A. C. CLARK
Raritan Copper Works, Perth Amboy, N. J.

Analysis of Aluminum Dust

By J. E. Clennell*

SYNOPSIS—The aluminum dust of commerce, used as a precipitant for recovering metals from cyanide solutions, contains a good many elements aside from aluminum. The dust is efficacious, of course, in proportion to the purity of the material. A scheme is here outlined for making a total analysis of the product.

In former articles[1] some account has been given of the methods developed at the Butters plant for the estimation of metallic aluminum in aluminum dust. In the present paper I shall describe the process of making a complete analysis of this product, so far as practicable with ordinary laboratory appliances.

The impurities present may be classified as metallic and nonmetallic. Of the former, iron is usually the most abundant and is invariably present to a greater or less extent, as a little is inevitably introduced during the grinding process. Copper and zinc are frequently found. A few samples have shown lead and magnesium. Some analyses reported from Russia indicate chromium, and a search was made in our laboratory for this element, but no trace of it could be found. Judging by the nature of the raw material from which the dust is manufactured, other metals might be looked for in the product—for example, arsenic, antimony, tin, manganese, nickel and sodium—but so far none of these has been detected in the samples examined. The only metals, the estimation of which will be considered in the following notes are aluminum, iron, copper, zinc, lead and magnesium.

The nonmetallic ingredients are moisture, grease, carbon, silicon, oxygen and nitrogen. The grease consists of one or more hydrocarbons of the paraffin series, introduced to facilitate the process of fine-grinding the granular product. It is present in most brands, though occasionally absent, and it is of interest in this connection to observe that the paraffin compounds used in our process of manufacture have no reducing action whatever on ferric sulphate or permanganate and consequently introduce no error in our standard test for metallic aluminum. Silicon, presumably, occurs in the elementary form or as a metallic silicide, not as silica, but is obtained in the latter form in the course of analysis. A small percentage of the aluminum and perhaps of other metals may be present as oxide or nitrate. As yet no methods have been devised by us for the determination of oxygen and nitrogen in these forms. Of the nonmetallic constituents, only the determinations of moisture, grease, carbon and silicon are here given.

General Method of Analysis

I shall first give an outline of a general method of analysis by which all the constituents considered may be separated in one weighed portion of the original dust. Special methods will afterward be given for more rapid or exact determination of particular constituents.

(1) Weigh out 1 gm. of the dust, place on weighed watch glass and heat in the drying oven to 100° C. Cool about 10 min., under cover, preferably in a desiccator. Weigh watch glass and contents. Repeat the operation of heating to 100° C., cooling and weighing until consecutive readings are practically constant. The loss of weight represents moisture. This method appears to be satisfactory, as the paraffin compound, although melted, is practically nonvolatile at the temperature used.

Transfer the dried material from the watch glass to a clean, perfectly dry, 200-c.c. beaker. Cover the sample with ether (commercial "sulphuric" ether may be used if free from residue on evaporation). Stir with a glass rod, settle and decant liquid through a 9-cm. filter. Continue washing in this way by decantation with small quantities of ether until a drop of the filtrate allowed to fall on a watch glass leaves no residue on evaporation. The filtrate is collected in a small, previously weighed flask. Filtrate, (2); residue, (3).

(2) When the extraction is complete, connect this flask with a condenser and immerse it in hot water; the latter need not be heated beyond the boiling point of ether, as the liquid should not be allowed to boil too violently. The ether is collected for re-use. The flask and contents after cooling are weighed, the increase in weight representing grease.

(3) The bulk of the residue will probably still remain in the beaker. Brush into a 300-c.c. conical flask, adding as much as possible of the material collected on the filter; to the same flask add 50 c.c. of water and place under funnel containing filter used in previous operation. In the beaker add 50 c.c. dilute hydrochloric acid (25% HCl by volume). Heat to boiling and pour gradually through the funnel into the conical flask, agitating the latter to break up the froth formed by the somewhat violent action. With care the bulk of the material may thus be rapidly dissolved without loss, but sometimes it may be necessary to cool the flask by immersion or use a more dilute acid. Finally, when violent action has ceased, heat to boiling and filter again through some paper into a second 300-c.c. flask, at the same time rinsing flask and beaker with hot water and collecting all washings in the second flask. Residue, (4); filtrate, (7).

Estimating the Silica

(4) Wash residue from paper back into the first flask. Add 50 c.c. of 50% nitric acid, boil off red fumes, dilute if necessary, and filter into a separate small flask, using same paper as before. [The quantities of acid, etc., may be varied according to the nature and amount of residue. This treatment usually suffices to dissolve everything except carbon and silicon. If lead is present, however, give a final wash with 5 to 10 c.c. of hot 50% HCl.] Extract with boiling water until the filtrate is free from chloride, which may be ascertained by testing with a drop of $AgNO_3$. Residue, (5); filtrate, (6).

(5) Dry the filter paper and contents without burning. Brush off the residue as much as possible into a small dish or watch glass. Incinerate the paper, add the ash and weigh together as carbon + silica + ash.

After weighing, brush into a nickel crucible, mix in about 0.5 gm. sodium peroxide and fuse for a few minutes at a moderate heat. Dissolve the melt in hot water, wash

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[1]"Eng. and Min. Journ.," May 6, 1916, and Aug. 12, 1916.

and remove crucible. Acidulate with HCl, evaporate carefully to dryness, take up with HCl and again evaporate to dryness. Finally boil with dilute HCl, filter and wash free from chlorides. [The filtrate from this operation always contains a little nickel from the crucible. It should be examined for copper, iron or other metals likely to occur in the sample. If these are absent, it may be rejected; if present, the amounts may best be determined separately and added to the principal quantities obtained later.] Dry the residue, ignite and weigh as silica + ash. The weight of silica $\times$ 0.47 = silicon (Si).

This procedure was adopted after many trials, as it was frequently found that the carbon resisted ignition very persistently and a white residue could not be obtained by the ordinary method of igniting over a blast lamp. A platinum crucible might preferably be used, but under present conditions such apparatus is, of course, beyond the dreams of avarice.

(6) Add 5 to 10 c.c. concentrated H_2SO_4. Heat to white fumes: cool; transfer liquid, together with any lead sulphate which may separate out, to the bulk of filtrate from the original extraction with hydrochloric acid, set aside in the 300-c.c. flask, and proceed as under (7).

(7) This filtrate should contain all the metals originally present in the dust, but a part of the lead may have settled out as a heavy white precipitate of $PbSO_4$. Heat to boiling, and pass a current of hydrogen sulphide, to saturation. Filter; wash with H_2S water. Residue, (8); filtrate, (11).

(8) Spread out the filter paper containing the precipitate in a casserole or evaporating basin. Cover with 50% HCl, adding a little H_2S water. Heat nearly, but not quite, to boiling, and again filter. Wash with hot water. Residue, (9); filtrate, (10).

The Determination of Copper and Lead

(9) This residue consists of copper sulphide, practically free from lead; place open paper in a dish or casserole. Cover with about 5 c.c. 50% nitric acid, adding more if necessary, and heat, without boiling, until the sulphide is decomposed. Filter off the separated sulphur; wash with hot water. Boil, cool, add 5 c.c. ammonia and titrate copper with standard cyanide.

If so much acid has been used that 5 c.c. of ammonia does not give a blue color, boil off excess of acid or neutralize with pure sodium carbonate before adding ammonia.

(10) The filtrate contains the lead, with perhaps a trace of copper. Boil to expel H_2S. Add excess of ammonia, then acidify slightly with acetic acid and add a few drops of a concentrated solution of potassium chromate. Boil 5 or 10 min. The lead is precipitated in a dense form as orange-colored chromate. Filter; wash free from soluble chromates and redissolve the precipitate in cold 50% HCl, or in hot HCl, cooling the liquid afterward. Add a few crystals of potassium iodide and determine lead by titrating the equivalent of iodine with standard thiosulphate. (For details see A. H. Low, "Technical Methods of Ore Analysis," Fifth Edit., p. 144.) Copper and lead are best determined by the direct methods given later, but a fairly good separation may generally be made as just described.

(11) Boil to expel excess of H_2S. Add 2 or 3 c.c. concentrates HNO_3; boil, neutralize cautiously by adding pure caustic soda in small pieces or as concentrated solution, continuing until the precipitate of alumina first formed has entirely redissolved, leaving a residue of ferric hydrate and possibly magnesia. Boil and allow to settle; filter, wash with hot water until practically free from alkali. Residue, (12); filtrate, (15).

(12) Dissolve the precipitate from the filter by passing through it about 20 c.c. of hot 25% hydrochloric acid, and wash with hot water. Add ammonia in excess and boil. Filter and wash with hot very dilute ammonia, avoiding unnecessary dilution of filtrate. Residue, (13); filtrate, (14).

Titration of the Iron

(13) Dissolve residue with about 25 c.c. of 25% sulphuric acid previously heated to boiling. Wash filter thoroughly with hot water, dilute liquid to about 150 c.c. in a flask provided with stopper and bunsen valve. Add one or two pieces of pure aluminum foil. Boil 15 to 20 min. Test a drop on a glass rod with thiocyanate solution to see that reduction is complete. If not, continue leaching, with addition of water if necessary. Cool. Titrate iron with permanganate. This may be done without removing the pieces of aluminum foil, if all action ceases on cooling.

(14) To the filtrate add 5 or 10 c.c. of a saturated clear solution of sodium phosphate. Agitate briskly and allow to settle overnight. Filter. Wash with a minimum quantity of 10% ammonia until free from chlorides (test with $AgNO_3 + HNO_3$). Dry, ignite and determine magnesium from weight of $Mg_2P_2O_7$ found.

(15) To the filtrate from $Fe(OH)_3$ and $Mg(OH)_2$ add about 10 c.c. of a strong solution of sodium sulphide. Boil thoroughly, settle and filter. Wash with hot water until free from alkaline sulphides, testing a drop of the filtrate with a lead solution. Residue, (16); filtrate, (20).

(16) If this residue is perfectly white, proceed at once as under 19. If dark-colored, redissolve in HCl, boil off H_2S, add a few drops of HNO_3, then excess of ammonia. Boil, filter, wash. Residue, (17); filtrate, (18).

(17) The small amount of iron which is sometimes precipitated here can best be determined by the colorimetric method described later, and added to the main amount.

Estimation of the Zinc

(18) Add sodium sulphide as in (15). Boil, settle, filter, wash with hot water until free from soluble sulphide. Residue, (19); filtrate, reject.

(19) Place filter paper and precipitate in a small stoppered flask. Cover with cold distilled water. Add a measured amount (say 10 or 20 c.c.) of $\frac{N}{10}$ iodine in KI. Agitate thoroughly and allow to stand about 5 min. Acidulate slightly with HCl. Titrate the excess of iodine with $\frac{N}{10}$ thiosulphate, adding starch solution near the finish. The difference between the amounts of iodine and thiosulphate used is the equivalent of the zinc.

If preferred, the zinc may be estimated by the ferrocyanide method, in which case the precipitate is dissolved in HCl, boiled to expel H_2S, allowed to cool somewhat, and titrated with standard ferrocyanide, using a uranium solution as external indicator.

When the quantity of zinc precipitate is very small, moisten the paper with a solution of ammonium nitrate, dry, ignite and weigh as zinc oxide. $ZnO \times 0.8035 = Zn$.

(20) The filtrate from the first precipitation of zinc sulphide contains the aluminum as sodium aluminate, with an excess of sodium sulphide and hydroxide. A rough determination of the aluminum may be made as follows:

Acidulate with hydrochloric acid. Boil thoroughly to expel H_2S and coagulate the precipitated sulphur so that it can be removed by filtration. Filter. Wash well with hot water, cool filtrate and make up to 500 c.c. in a measuring flask. Mix thoroughly. Tests are then made on portions of 100 c.c., which represent 200 mg. of the original sample.

Add two drops of a 0.1% solution of methyl orange; run in normal caustic soda until pink color appears, again acidulate slightly with HCl and add normal soda cautiously until the color change is just permanent on agitation. Note reading of burette. Run in normal soda, add a few drops of phenolphthalein and continue adding the alkali until a permanent pink tint is formed. Again note reading of burette. The interval between the points of color-change with methyl orange and phenolphthalein respectively is proportional to the amount of aluminum. Tests with this method of titrating aluminum gave results showing a variation of about + 2%. The color changes, making the two points, are not absolutely sharp, and the method is only recommended for rough approximations. One possible source of error, the presence of carbonates in the normal soda solution, may be eliminated by the addition of a little chloride or hydroxide to this standard solution. The caustic soda may be standardized on a solution of aluminum chloride containing 1 gm. Al per liter (1 c.c. = 1 mg. Al) prepared by dissolving pure aluminum foil or granules in hydrochloric acid.

In most cases this general method of analysis may be considerably simplified, owing to the absence of one or more of the constituents to be separated. Thus lead is rarely present, and usually only copper need be looked for in the group precipitated by H_2S in acid solution. The ordinary course of separation is varied somewhat, as it is desirable to keep the aluminum in solution until all impurities have been eliminated; for this reason caustic soda is used rather than ammonia, for precipitation of iron.

Special Method for Particular Constituents

The determination of silica given in the foregoing general method is open to the theoretical objection that silica might be present in a form soluble in hydrochloric acid and would consequently pass into the filtrate. Tests were therefore made in which 1 gm. of the dust, after removal of grease by means of ether as described, was evaporated to dryness in a porcelain dish or casserole. The operation is tedious, owing to the large amount of soluble salts which crystallize out, and a low temperature must be used at the finish, to avoid loss. To insure complete solution of the copper, a little nitric acid should be added. When the residue is perfectly dry, allow to cool somewhat and add 5 to 10 c.c. HCl. Again evaporate. Repeat this addition of HCl and evaporation a second time. Finally take up with dilute HCl, heat to boiling, settle, filter and wash free from chlorides. Ignite and weigh.

If a white residue is not obtained by this means, fuse in a nickel crucible with sodium peroxide, and proceed as described in general method, section (5).

Many methods for the direct determination of iron have been investigated in our laboratory. The most satisfactory results have generally been obtained by bringing the metals into solution as suplphates, reducing the iron to the ferrous state and titrating with permanganate. Since hydrochloric acid or *aqua regia* are much more rapid solvents of aluminum than sulphuric acid, the obvious procedure would be to dissolve in dilute HCl with the addition of a little HNO_3, then add H_2SO_4, evaporate to white fumes, cool, dilute, filter and apply a suitable reducing agent to the filtrate. Owing to the large quantity of soluble salts, however, the manipulations are troublesome, and the solution is very apt to spirt on concentrating. It is therefore better to dissolve as much as possible by direct treatment with H_2SO_4 and treat only the residue insoluble in that acid with *aqua regia*.

Determination of Iron and Copper

The following scheme, although rather long, has been found to give excellent results:

Take 1 gm. of the sample. Place 200-c.c. beaker, cover with ether and extract grease as described in the general method, section (1). Brush the residue from beaker and filter as much as possible into a 300-c.c. flask (marked No. 1). Place the flask under the funnel containing filter paper used in filtering the ether extract. In the beaker add 50 c.c. of sulphuric acid (12% H_2SO_4 by volume). Heat to boiling and pour through filter, collecting filtrate in flask No. 1. When liquid has drained through, place a clean 300-c.c. flask (marked No. 2) under the funnel. Heat contents of flask No. 1 to boiling and continue boiling gently until action has practically ceased, usually requiring 20 to 30 min. Add water to about original volume and filter through same paper as before to flask No. 2, retaining undissolved residue chiefly in flask No. 1.

Place filter paper, opened, in a dish or casserole; add 5 c.c. 50% HCl and 5 c.c. 50% HNO_3. Heat gently, finally almost to boiling. Pour liquid into flask No. 1 and wash off all residue from the paper and beaker into same. Concentrate to small bulk. Add 5 to 10 c.c. concentrate H_2SO_4 and boil to white fumes. Cool. Add 5 c.c. water, boil and filter through fresh paper into flask No. 2. Wash with hot water.

The whole of the material soluble in acids is now in flask No. 2. Occasionally it may be necessary to examine the residue still remaining undissolved, by fusion with soidium peroxide as described in general method, section (5), but in most cases the treatment described suffices to dissolve the whole of the iron and copper.

Add two or three pieces of pure aluminum foil, bent at the corners, fit stopper with bunsen valve in neck of flask and boil gently. For complete precipitation of the copper, I have found it safer to allow at least 30 min. boiling. Remove a drop on a glass rod, and test with KCNS to make sure that reduction is complete. Cool to room temperature. Remove stopper and decant liquid carefully into a clean flask. Wash twice by decantation with cold water, leaving the whole of the precipitated copper and the pieces of foil in flask No. 2. At once titrate the decanted solution for iron with permanganate.

In flask No. 2 now add 5 c.c. of 50% HNO_3, warm gently, see that every particle of copper dissolves; pour into another flask, wash several times with water, pouring the liquid into the same flask, but retaining the clean

pieces of foil in flask No. 2. Heat decanted solution to boiling, cool to room temperature, add 5 c.c. strong ammonia, cool again if necessary, and titrate with cyanide.

Where the quantity of copper is considerable, the iodide method is preferable. In this case, after adding ammonia as mentioned, boil down to about 30 c.c., acidulate slightly with acetic acid, again boil, cool thoroughly, add 1 to 3 gm. of potassium iodide and titrate into standard thiosulphate, using starch indicator when near the finish.

Very small amounts of copper are best estimated by solorimetry in the ammoniacal solution, by comparison with standards of known copper contents, containing approximately the same volume of liquid and the same amounts of acid and ammonia.

Weigh out 100 mg. of the sample. Add 20 c.c. 25% hydrochloric acid and 5 c.c. 50% nitric acid. Heat to boiling; the material dissolves very rapidly, usually leaving only a minute residue of grease carbon and silica. Dilute somewhat, filter and wash with hot water. Make filtrate up to 100 c.c., cool thoroughly and add 5 c.c. of a 1% solution of potassium thiocyanate.

A blank test is run simultaneously, using exactly the same treatment and same quantities of acid, filter-papers and thiocyanate, but omitting the aluminum dust. To the solution of the blank, run in standard ferric chloride until the tint of the liquid is the same as in the solution of the sample. The amount of ferric chloride used indicates the amount of iron in the latter.

The standard ferric chloride is made by dissolving 1 gm. pure iron wire in, say, 25 c.c. of 25% HCl and 1 c.c. concentrate HNO_3; boil thoroughly, cool and dilute to 1000 c.c.

One c.c. of the solution = 1 mg. Fe = 1% on a test of 100 mg. Al dust.

Take one gram of the dust. Remove grease by treatment with ether as previously described. Dissolve the residue as completely as possible by boiling with 50 c.c. normal caustic soda. If the action is very violent, dilute somewhat. Filter and wash with hot water. To the filtrate add 5 to 10 c.c. concentrated sodium sulphide. Boil thoroughly, settle, filter and wash free from soluble sulphides. If the precipitated sulphide is white, the zinc may be at once determined by means of standard iodine and thiosulphate, as described in general method, section (19). If a dark colored precipitate is obtained, dissolve in hot HCl, pass H_2S to remove copper, filter, boil off excess H_2S, add a drop or two of HNO_3, then ammonia in excess, boil, filter and again precipitate the zinc in the filtrate by means of sodium sulphide.

The Lead Determination

Take one gram of the sample. Remove grease as described in general method. Dissolve the bulk of the residue in sulphuric acid, as described in detail in special method for iron and copper, but allow the solution to cool and settle thoroughly before filtering. Treat the residue insoluble in H_2SO_4 by boiling with *aqua regia*, and finally heating to white fumes with a few c.c. of sulphuric acid. Dilute, boil again, cool, settle and filter through same paper as before. Wash well with 10% H_2SO_4 until the residue is free from iron or copper.

The lead is now contained in the residue as sulphate, mixed with carbon and silica. It may be extracted by treatment either with hot ammonium acetate slightly acidified with acetic acid, or with boiling 50% hydrochloric acid. In either case make the extract slightly alkaline with ammonia, then very slightly acid with acetic acid, add chromate solution and proceed as described in general method, section (10).

The following analyses may be taken as typical of the products commonly placed on the market. The low-grade dust is made from automobile castings and similar material; the high-grade from pure aluminum wire and scrap.

ANALYSES OF ALUMINUM DUST

	(1)	(2)	(3)	(4)	(5)	(6)
Aluminum, Al	80.02	76.13	93.50	93.29	95.20	94.50
Iron, Fe	4.16	5.49	0.59	1.59	1.70	1.00
Copper, Cu	3.99	5.24	0.16	1.34	0.17	0.20
Zinc, Zn	3.83	4.40	0.44	1.03	0.03	0.05
Carbon, C	1.20	2.51	0.42	0.47	....	
Silicon, Si	0.24	0.43	0.39	0.64	0.50	0.09
Grease	3.60	2.97	1.50	0.79	1.80	2.82
Moisture	0.09	0.12	....	....	....	....

The Copper Producers to the Government

This is what the copper producers of the United States are going to do in providing the United States with copper for the army and navy.

For more than a week Bernard M. Baruch of New York, chairman of the committee on mining and metals of the Council of National Defence, has been in conference with representatives of the large copper mining and smelting interests. As a result of this Director Gifford of the Council made the following announcement on Mar. 21:

The following letter, signed by nearly all the copper producers of the country, was received today by Mr. Baruch:

"Referring to our several conversations on the subject of supplying copper for the army and navy, to the letter of the Secretary of the Navy of Mar. 16, and the telegram of the Secretary of War of Mar. 18, both addressed to you, on behalf of the principal producers of copper in this country, we beg to say that we will furnish the quantity named for delivery within twelve months, viz.:

"Twenty millions (20,000,000) pounds for the navy and twenty-five million five hundred and ten thousand (25,510,000) pounds for the army, in approximately equal quantities each quarter from April, 1917, to April, 1918, at a price of 16.6739c. a pound, delivered in regular shapes at Atlantic seaboard points.

"The price named is the actual average selling price obtained by the United Metals Selling Co., the largest seller of copper, over the period of ten years, 1907 to 1916 inclusive, and represents in our opinion the fair average price of all copper sold by American producers during that time.

"We offer the copper at this price notwithstanding our costs for labor, materials, supplies, etc., vary from 30 to 75% above the average during the ten year period because we believe it to be our duty to furnish the requirements of the Government in preparing the nation for war with no profit more than we receive from our regular production in normal times. It is understood that the price quoted above is for the quantity and period of delivery above named."

Director Gifford concluded:

"This willingness to furnish the copper supply needed by the Government at a maximum concession in price is a very gratifying evidence of the recognition of men of large affairs of their patriotic obligation and both the War and Navy Departments appreciate their generous and public spirited attitude."

Details of Practical Mining

Boiler Horsepower Saved by a Feed-Water Heater*

By W. F. Schaphorst†

The feed-water heater is a device that is not sufficiently appreciated. Some men have the idea, that they are a theoretical rather than a practical addition to the power

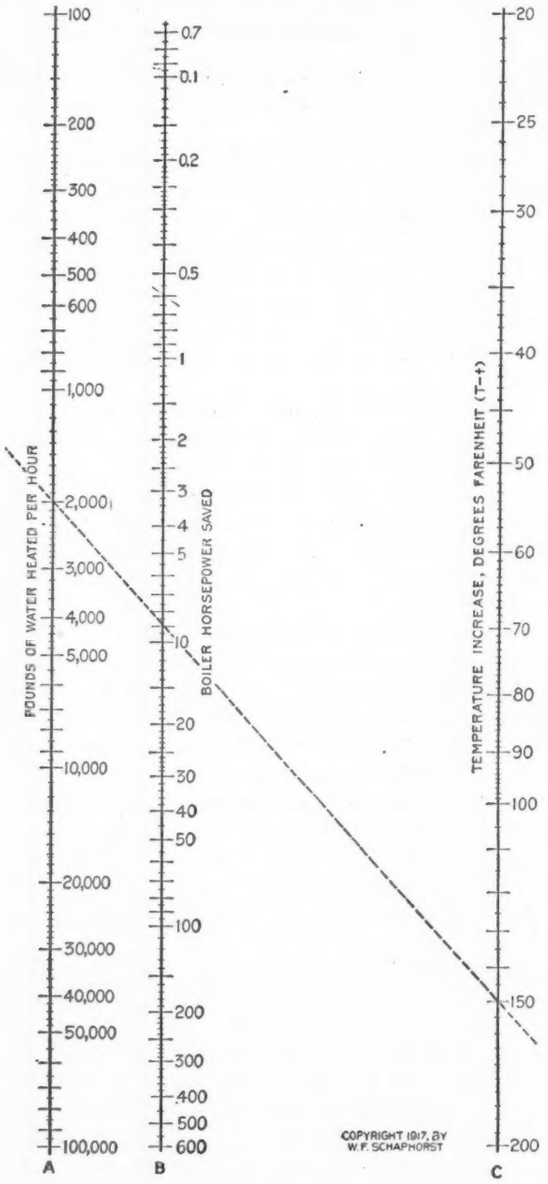


CHART FOR DETERMINING SAVING IN HORSEPOWER BY USE OF FEED-WATER HEATER

plant. Manufacturers advertise a saving of from 10 to 25% on coal by the use of feed-water heaters. In order to prove the truth of this I have developed the accompanying chart, which is extremely simple in use. Just lay a straightedge across the chart, and column B gives the boiler horsepower saved by a feed water heater. For example, if you use 2000 lb. of water per hour and if a feed-water heater will increase the temperature of the feed 150° F., how many boiler horsepower will the heater save? Connect the 2000 (column A) with the 150 (column C) and column B shows the saving to be 9 boiler horsepower, as indicated by the dotted lines drawn across this chart. In other words, the feed-water heater virtually gives you 9 boiler horsepower for nothing. It utilizes the steam that would otherwise go to waste. Or, if your present boiler is a 60-hp. unit and you add the heater, you can then get 69 hp. out of the boiler without burning any more coal.

Moreover, this chart does not show the additional saving due to keeping scale out of the boiler, which often amounts to 25% in itself, and that, also, should be considered. The range of the chart, it will be seen, is great enough to handle the conditions in any ordinary small or large power plant; 600 hp. saved is the maximum.

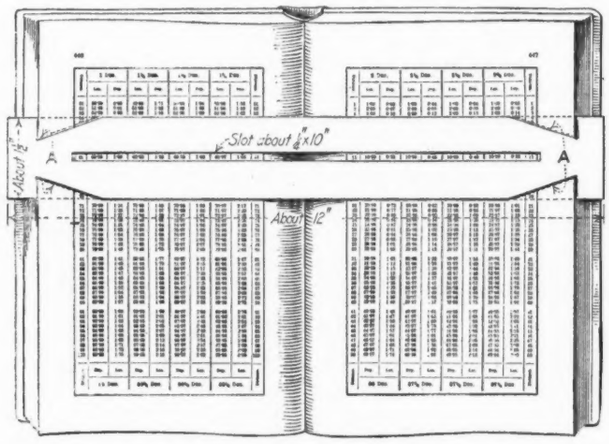
*Copyright, 1917, by W. F. Schaphorst.

†Mechanical engineer, Woolworth Building, New York.

Indicator for Tables

The instrument described below by T. Edwin Smith[1] is useful in reading data from traverse tables. It can be made out of a piece of cardboard, or celluloid.

The construction is clearly shown. In operation the book is opened at the page desired and a couple of leaves



SIMPLE DEVICE TO FACILITATE READING DATA FROM TRANSVERSE TABLES

inserted on each side under the points marked *A* at each end. In this position the runner can be slipped up or down the page and readings across the page can be secured without any chance of reading the wrong line. The slot can be made the proper width to show only one row of figures, although it is better to have it a little wider as few books open perfectly straight and in line.

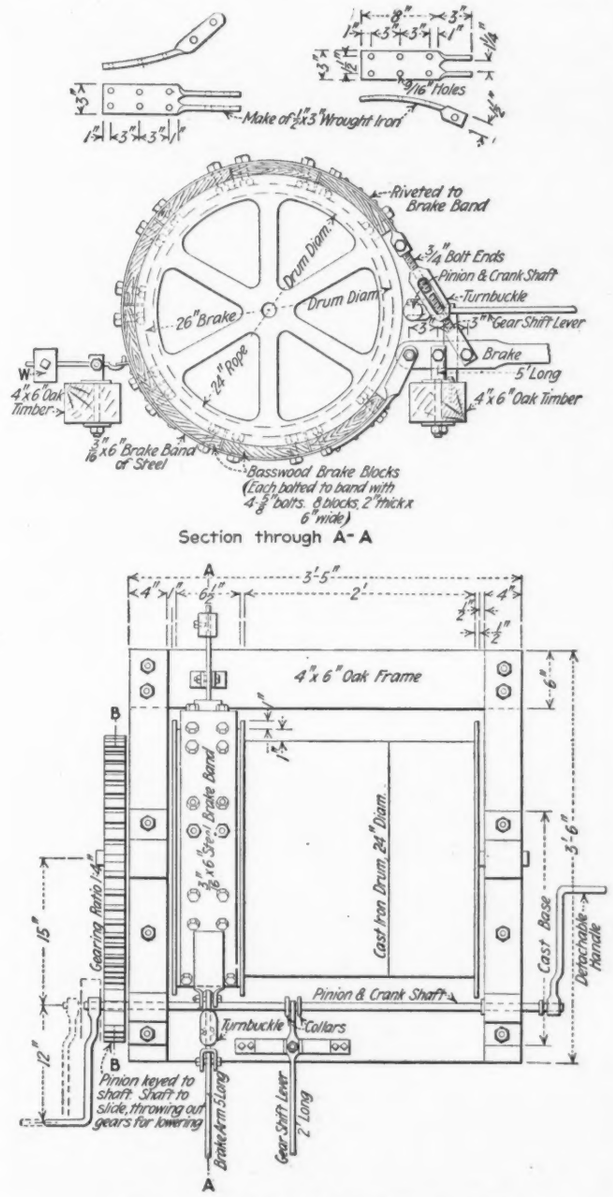
[1]Carmangay, Alta., Canada.

Shaft Winch for Supplies

By C. F. Jackson*

On the Mesabi Range, timber, lagging, mine cars, powder and other supplies are commonly sent into the mine through "timber shafts," instead of through the main hoisting shaft, there sometimes being five or six timber shafts to serve a single mine.

The material lowered through this timber shaft is ordinarily handled by means of a common windlass with



DETAILS OF SHAFT TIMBER-WINCH

brake attachment. In 1914-15, with the common windlass we had a number of accidents at our mines due to handling too heavy loads, it being impossible for the lander to hold the load, after raising it clear of the shaft collar, with one hand, while applying the brake with the other. It was therefore decided to install a winch for raising the load above the shaft collar. We could not find on the market a winch designed primarily for lowering, with means provided for readily disengaging the gears, and the winch shown in the accompanying sketch was therefore designed. Three winches of this type were built and installed in April, 1915.

In operation, the lander throws in the gear by means of the shift lever and hoists the load clear of the shaft collar. The brake is then applied, the pinion thrown out of gear, and the load lowered on the brake. Two ropes, wound on the drum in opposite directions, are used, so that the loaded end brings up the empty chain and there is always a chain ready to which to attach a load at the surface.

*Chief engineer, Central District, Arthur Iron Mining Co., Hibbing, Minn.

Waterproofing Leather Boots

Treating leather boots to make them waterproof is a subject of much interest to engineers, miners and prospectors where snow, wet workings and rainy weather are to be contended with.

The time-honored method of rubbing mutton tallow on the boots and then standing them near the fire so that the tallow can melt in is good, but troublesome and nasty. There are several liquid preparations sold on the market, warranted to make leather waterproof. As a rule, however, these are expensive and do not do the work. Most of them, while making the leather soft and pliable and probably adding to its life, seem to allow the water to pass through the leather faster than when not used. Neat's-foot and castor oil, when freshly applied, are waterproofing, but the effect is short-lived. Any liquid to be thoroughly waterproofing and at the same time have a lasting effect must consist of a gummy base and a dissolving liquid. The latter makes it possible to spread the mixture and also carries the gummy ingredient into the leather.

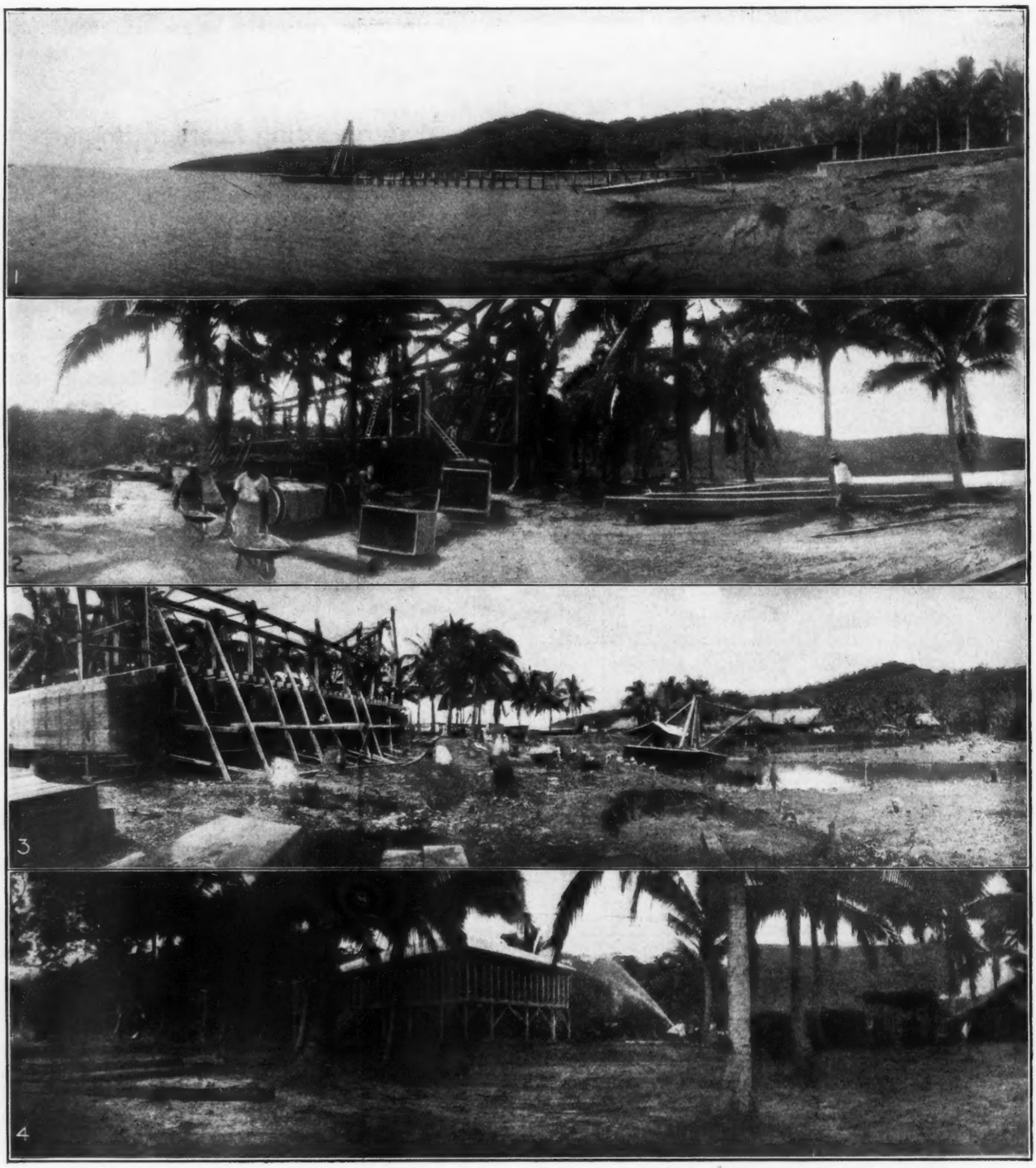
A mixture that is waterproof can be prepared by melting rubber into a pan of boiling grease. The rubber from old rubber boots will do; it should be burned over the grease and the molten matter allowed to fall into the pan. Another mixture just as good can be made by substituting the gum from any of the evergreen trees for the grease in the mixture just described. Either of these preparations is decidedly disagreeable to make, but when applied hot to leather boots will positively make them waterproof.

To Remove Paint Chemically

To remove paint from iron and steel surfaces the following formula is prescribed by the United States Coast Artillery Corps, and the method is used in cleaning the exterior surfaces of the big guns and carriages in our coast defenses.

One pound of concentrated powdered lye is dissolved in six pints of hot water, and enough lime is added to make the solution thick enough to spread. It is then applied, freshly mixed, with a brush, and allowed to remain until it is almost dry. When it is then removed, it will take the paint with it. In case the paint is very thick and very old, it may be necessary to wash off the surface and apply a second coat of this emulsion. After the old paint has been entirely removed and before a new coat of paint is put on, the metal should be washed with a solution made of one-half pound of washing soda, or salsoda, dissolved in eight quarts of water, after which, of course, the parts should be thoroughly dried.

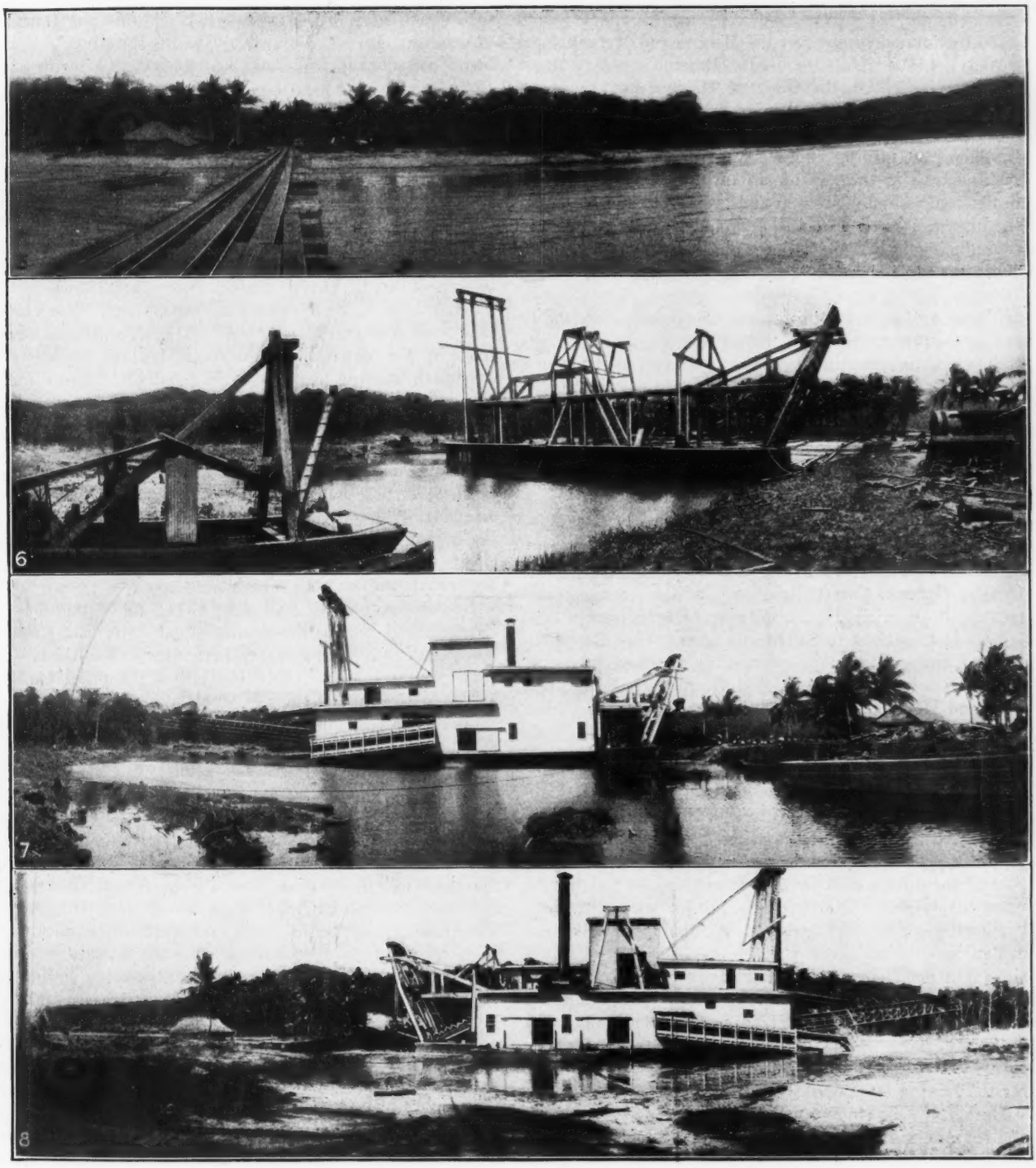
Gold Dredging in Mambulao



MAMBULAO PLACER CO., OF MANILA, IS DREDGING FOR GOLD IN

This American dredge started last July just back of Mambulao Bay and has since dug its way into the salt water of the bay. It was built by the New York Engineering Co.; is designed to dig 55 ft. below water line and has a number of special features. It has a wooden hull, sheathed with hair felt, which is in turn protected by 1½-in. boards; the air in the hull is changed every 10 min. by the ventilating fan of the turbo-generator. This is the first gold dredge to have a steam-electric power plant on the dredge, all power being applied from electric motors supplied with current by the

Bay in the Philippine Islands



MAMBULAO BAY, PROVINCE OF AMBOS CAMARINES, ISLAND OF LUZON

500-kw. turbo-generator; steam is furnished by a water-tube boiler which burns about 12 cords of wood per day. The dredge has 8-cu.ft. buckets and is equipped with a bypass chute (shown in No. 8) for disposing of clay and overburden without passing it over the gold-saving tables. Views 1 and 5—Mambulao Bay, where dredge machinery was landed and into which it eventually dredged its way; 2 and 3—hull during construction; 4—staff cottage; 6—hull after launching; 7—dredge ready for bucket line; 8—digging its way to Mambulao Bay

Mining Engineers' Work in Belgium

SYNOPSIS—Address by D. H. Browne on H. C. Hoover and the work of American mining engineers in Belgium, delivered at the annual meeting of the Mining and Metallurgical Society of America.

At the annual meeting of the Mining and Metallurgical Society of America, David H. Browne made a most gripping speech on the work of Hoover and American mining engineers in the Belgian relief work. This work is far from being akin to mining, but it is being directed by American mining engineers in a way that is epoch-making both in the way of philanthropy and the mining profession. For that reason and because it was presented in Browne's most forceful and felicitous way, we are reproducing it here in full for the benefit of our fellow engineers far afield.

There are in every profession men whose personality and accomplishments raise them above the level of their colleagues, and they in turn raise their profession to new standards and their confreres to their own level.

Take a concrete example. Much as Edison, Steinmetz and Pupin owed to the work of their forerunners in electrical invention, yet the profession is in debt today to those men for the work they have done and for the honor they have conferred upon their fellows in raising a new standard in electrical engineering. There is no civil engineer but has received some share of the glory accruing to Goethals, Gaillard, and the men who dug the Panama Canal. Carrere, Cass Gilbert and McKim have set new records in municipal architecture. Every metallurgist is under obligations to Sticht, Mathewson and Cappelen-Smith; and so today every mining engineer is deeply indebted to men like John Hays Hammond, Pope Yeatman and Herbert C. Hoover.

Creators of New Ideals

Such men create a new horizon, envisage large ideals, invest old things with a new meaning. You and I remember that 30, even 20, years ago, the mining engineer was regarded with amusement tinged with suspicion. His report was accepted, but before any real money was expended the advice of some old Cornish miner was sought upon the subject. The mining engineer was a theorist; "yellow-legged expert" was the common term for him. Today you do not hear that epithet. Why? Because time is a good story teller and honest work counts up. You and I profit today from the clean, clear thinking of our fellow engineers. Their accumulated reputation is our working capital; their success illuminates our future. So I want to tell you what Hoover has done for the mining engineers.

Herbert Clark Hoover was born in Iowa in 1874. He studied mining at Leland Standford University and graduated there in 1895. After a year on the geological survey he became assistant manager of the Carlisle and the Morning Star mines. His work there was so successful that in 1897 he was asked by Bewick, Moreing & Co. to become their chief of staff in West Australia, a position which he held for three years. In 1900 he was called by the Chinese government to take charge of the Cninese Bureau of Mines, and a year later he became general manager of the Chinese Engineering and Mining Co. In 1902, at the age of 28, he was made partner of Bewick, Moreing & Co. and director of their mining activities. Of his instant success in whatever he became engaged; of his home in London and its hospitality to all; of his translation of the old German treatise on mining, Agricola's "De Re Metallica"; of his own book on the same subject; and of his lectures at Columbia, I have no time to tell you. The year 1914 found him in London, wealthy, successful and honored in his work as are few men at the age of forty.

Hoover's Aid Enlisted

On the morning of Aug. 4, 1914, Mr. Skinner, the American Consul in London, called Mr. Hoover on the telephone. "Mr. Hoover," he said, "there's a mob of American citizens here at the consulate, trying to change letters of credit, bank drafts, and express orders for English gold. We are swamped with them. For God's sake come over and help us out." Mr. Hoover came over, took in the situation at once and called up all the American mining engineers in London. "How much money have you in your safes?" he said. "Get all the cash you can raise at once, get in the back door of the banks, get money immediately, get it any way short of petty larcency."

These men responded to his call. They worked night and day. They raised about $200,000 themselves and the government loaned the same amount. Through the efforts of this informal committee of mining engineers 42,000 Americans were sent home happy.

By the month of October, 1914, the situation in Belgium had become desperate. A population of 9,000,000 people was facing starvation. Brand Whitlock, the American ambassador, with the aid of the other ambassadors of neutral countries, took up the matter and obtained an agreement from the invading army to the effect that food might be imported for the use of the civil population. This was ratified by the German government. With the assistance of Ambassador Page a similar agreement was obtained from the British government, and permission was sought from Washington to allow American citizens to collaborate. Remembering the work which had been done by the American mining engineers in London, Mr. Page asked Mr. Hoover to undertake the formation of a committee to handle this work of relief in Belgium and Northern France. On October 22, the first meeting of these American engineers was held in London, and the first food was sent to Belgium on Nov. 1, 1914.

Hoover's way is to do things first and to ask permission later. He and his associates had only $500,000 promised, but with this in sight, they arranged to place orders for 20,000 tons, or $2,000,000 worth, of food a week. They purchased the food, transported it to the docks, chartered vessels and loaded them. Then, when the hatches were closed, Hoover sought permission to make shipment. He went before the proper official. "Unless I get four shiploads of food to Belgium before the end of the week those people will starve," he said. The high official deeply regretted his inability to aid him. The food could not be purchased, the railways were

choked with munitions of war, the ships were all under government orders, and furthermore, the Channel was closed to commerce.

Mr. Hoover heard him to the end. "I have attended to all this," he said. "The ships are loaded and ready. All I need now is clearance papers, and I have come to you for these because you are the only man who can grant them." The official gasped. It was incredible, unheard of. "Young man," he said, "there have been men sent to the Tower for less than you have done. If it were any one else or for any other cause, I hate to think what might happen; but, as it is, all I can do is to congratulate you on some very good work."

Hoover always moves that way. When the thing is done, when it is *fait accompli*, then and only then does he consider the established methods. "It's an engineer's job," as he said.

What Is This Engineer's Job?

What is the engineer's job he talks of? Here is a country about as big as the State of Maryland, containing approximately 9,000,000 people, or 650 to the square mile. One-third of these live by cultivation of the soil, two-thirds by various mining, smelting, and manufacturing industries. Suddenly the whole mechanism of civilization comes to a standstill; industry ceases; banks and shops close; trains, telephones, telegraphs, postal service stop; food can no longer be harvested, sold or shipped. What follows? Starvation.

To keep these people alive, Hoover and his fellow engineers had to assume diplomatic standing and negotiate with the belligerent governments a series of agreements—treaties would be a better word—treaties of foreign governments with a body of American mining engineers. These cover: Permission for transportation of food through belligerent lines, immunity of shipping from attack, distribution to civil population only, protection of native food from requisition, permission to engage in trade and banking, securing of government subsidies, freedom of staff movement and communication.

All this was arranged in an incredibly short time, and for 2½ years this machine has functioned, supplying to 9,000,000 people the necessities of life. This Commission for Relief in Belgium, the C. R. B., as it is called, has kept its neutrality. It has no share in this war, it takes no sides, and has the respect of all the governments with which it deals. The German army and the imperial government have strictly adhered to its agreements and have permitted the use of railways, roads, canals and other transportation in the conquered country. In April, 1915, through some mistake, one relief ship was torpedoed and an aëroplane tried to drop a bomb on another. Mr. Hoover took a flying trip to Berlin and was assured that it would not happen again. "Your Excellency," he said, "there was a man once who was annoyed by a snarling dog. He went to see the owner and asked him to muzzle the dog. 'There is no need of that,' said the owner, 'the dog will not bite you.' 'Maybe,' said the man, 'you know the dog will not bite me. I know the dog will not bite me, but does the dog know?'" "Pardon me one moment, Herr Hoover," said the official, "I will telephone at once and let the dog know."

So, as I say, the machine works; selling food to those who can buy, taking the labor of others in exchange for bread, giving to those who have neither money to pay, nor service to render; keeping 9,000,000 people alive since November, 1914.

When these men started this work they had $500,000 in sight. Up to Oct. 31, 1916, the Commission has received and expended $201,720,079. Of this, the British and French governments have loaned to Belgium $108,121,358. The Commission has received through exchange operations $4,001,446. There has been loaned by French institutions to communes in Northern France $66,155,501. The rest of the money expended, amounting to $23,441,774, has been given by voluntary contributions, and of this, $8,747,138 has come from the United States. Out of this, however, $1,220,000 came from the Rockefeller Foundation. The total private contributions from the United States amount to about seven cents per capita. Seven cents apiece from the wealthiest nation in the world! Not quite three cents a year! We have much to be proud of, but not of that.

Having once set their hands to this work, Hoover and his friends cannot let it drop. These men have neglected their own interests, yet when a short time ago it was represented to the belligerent governments that the personal sacrifice these men were undergoing was more than they could bear, the same reply was given by both sides, that this American Commission was the only body that could be trusted to maintain strict neutrality and keep the confidence of all, and if they could not carry it on the work must drop. So they must perforce do as they have done, sacrifice their time and interests, give their work and their money, that these people may live.

As I said, they are feeding 9,000,000 people. By this I do not mean feeding as you and I use the term. The ration which they distribute is one-third less than that given to the pauper inmates of English workhouses. It sustains life, that is all. These men, women and children, as Maeterlinck says, "for two years have not eaten according to their hunger." Even such food as is given cannot continue, for the Commission is falling behind at the rate of $3,000,000 per month.

A Million Little Children Weak, Tubercular and Ill-Nourished

The children, how have they fared on this? Hoover writes us that a commission of doctors report a million little children are weak, tubercular, ill-nourished, and unfit to withstand the winter. To help them, the Commission is trying to provide a special meal in the middle of the day; a very simple meal, but adapted to their requirements. It costs three cents a meal, one dollar a month for each child. Yet, to feed these million children, $12,000,000 is required for the coming year. The Commission has not the money to do it. Already, at each feeding place, Belgian women are stationed to take from the ranks of waiting children those who are not actually starving. In many cases, those who were fed yesterday must wait until tomorrow. Could you drag your child from his dinner? Could you do it, gentlemen?

Did you hear Mr. Honnold tell the story of the four-year-old boy at one feeding station in Belgium, the little boy who cried when they gave him an egg? He did not remember ever having seen eggs; did not know what an egg was, nor how to eat it. When we heard this at a meeting of the New York Section of the American Institute of Mining Engineers, we got together, as one of us said, "to put that kid wise to eggs." We didn't

try to raise $12,000,000, or even $1,000,000. We tried to raise $120,000, just 1% of what Hoover asks the American people to give this year for those children. We formed a committee of 60 prominent mining engineers, two from each state, if possible, and asked them to help us raise the sum so we might cable it to Hoover for his Christmas present. We wanted to be able to tell him that 4000 mining engineers in the United States would take care of 10,000 children this year. Have we got it? No, we haven't; we have about a third of it. Four thousand letters were sent out, asking every one of our members here to show what they thought of the work of our own members on the other side. We had replies and contributions from 390 men, not quite one man in ten. The total amount contributed to Jan. 1 was $40,692, and of this one check for $10,000 came from a friend who is not a member of our society. Here is the way the states responded; I will not mention them all: Alabama, two replies from 536 members, total $24. Twenty-four dollars! How much pig iron can you buy in Alabama for $24 today? Arizona, 27 replies, and a total of $1224—from Arizona, with copper at 30c. and silver at 75. California does better and sends 38 replies and $3396 from the 433 members who received our appeal. Illinois gives $266. Massachusetts sends $648; New Jersey contributes $1188; New York sends 85 replies from 630 members and forwards $12,912 from members and this check for $10,000 from a friend. And so on down the list. Pennsylvania, $1000; Utah, $1068. But why prolong the tale?

What Has Not Been Done

We have not done what we set out to do. Do you realize why I speak to you about this? First, I speak to you as engineers. Do you or do you not approve of the work Hoover and the American engineers are doing? Do you know that one of these men, a friend of mine, and yours, who was making over $50,000 a year from his profession, gave it up to go into this work, and has put all his time on this? When that man looks on us, self-satisfied and busy, making money out of this war, when he sees how little we are doing for this work, how small is our help and appreciation, he says to himself, "I must be a fool." I tell you, gentlemen, God has need of fools like this.

I speak to you as engineers, because there is a concerted move today in England and her colonies to get rid of the American engineer. They say that we are profiting by their misfortune, taking the bread from their mouths. Can you stand this stigma, or will you show that it is unjust?

I speak to you as men. This work we are trying to do is for the children, and busy as the devil is, these children have had no part or lot in this war. They are children like yours and mine, hungry as—thank God—yours and mine have never been, and please God, never will be. I am not asking you here to contribute more than you have done. The easiest thing in the world is to put your hand in your pocket. You have already given money. Now I ask you to give something more difficult, your personal enthusiasm and individual effort in this cause.

I am much pleased to learn that the Mining and Metallurgical Society of America, which has never been tethered by the umbilical cord of precedent, has today given its official sanction to this voluntary movement by our committee of sixty. So far we have not asked for a similar indorsement from the American Institute of Mining Engineers; we have been too cautious; too fearful lest we might offend someone. How the feeding of a child could offend anyone is something I cannot understand. The more I look into this matter, the more I am convinced that since the Commission for Relief in Belgium bears the approval of the German government, it should also have the approval of our brother engineers of German descent. Now that Hoover is on his way to this country, we intend to ask the American Institute of Mining Engineers for a formal indorsement of his work, so that we can meet him unashamed.

When I ask you tonight, gentlemen, I ask you for the sake of humanity, for the sake of the honor of our profession, and for the sake of Hoover and his associates who have done so much for us.

Since this address was delivered the American Institute of Mining Engineers has indorsed this movement and Hoover, after a short period of tremendous effort, has sailed again for the scene of his colossal endeavor.

The Question of Wooden Ships

Chicago Correspondence

In reference to the preparation to build a large number of small wooden cargo carriers for overseas transportation, it is indicated that the lumber interests of the United States and Canada will be able to come immediately to the aid of the world to prevent a famine in ocean carriers because of the submarine warfare. The conference on Wednesday, Mar. 14, at Washington, between the shipping board, lumbermen and other interested parties brought a request to the lumbermen of the country to aid in the supplying of merchant ships.

Owing to conditions in the steel market and the time required for the construction of steel ships, the wooden ship is coming back into its own, largely in the form of schooners with auxiliary engines, mainly internal-combustion types. There are 68 wooden vessels under construction on the United States Pacific Coast, with a combined carrying capacity of 88,563 tons, or an average of over 1000 tons each. Each vessel requires 1,250,000 ft. of lumber in its construction, and is built mainly for lumber carrying, though available for any variety of cargo offered. They have a capacity of 1,500,000 to 2,000,000 ft. of lumber each. Inasmuch as the plant facilities for building these vessels are not expensive or detailed, this type of ship can readily be built in large numbers. In the war of 1812, it will be recalled, Commodore Perry converted trees from the forest into warships in 90 days, and this time can be beaten on modern larger ships by the improved equipment easily obtainable.

There is a revival of the building of schooners such as formerly constituted the chief bulk of the Great Lakes fleets, practically all of which have been sent down the lakes for Atlantic coast charters.

The United States has just felt this need. In Canada, however, shipbuilding has become one of the great war industries of the Dominion, there being contracts placed for ships at a total cost of $209,000,000. There are seven schooners of the American type being built now in British Columbia, with a total capacity of 10,500 tons.

A. S. & R. Co.'s New Insurance Plan

Under date of Mar. 20 the American Smelting and Refining Co., announces a new and comprehensive insurance plan for all its employees. Two circulars, Nos. 344 and 345, dated Mar. 7, give all details; the former is given herewith in full and that portion of the latter which is not duplicated in the former.

The American Smelting and Refining Co., (the American Smelters Securities Co. likewise), in further development of its policy in matters relating to Labor and Welfare, has adopted the following plan of Group Life Indemnity for the benefit of its workmen and their families or dependents:

Circular No. 344

Effective as of Jan. 1, 1917, the Company at its own expense will issue to each wage-earner employed at any of its plants, mines or mills in the United States, who has been in the service of the Company for one year or more, a certificate of indemnity paying, in the event of death for any cause while in the employ of the Company, $1000 to the families or dependents of married men and $500 to the dependents of single men. On the marriage of a single man, the amount of his indemnity will at once be increased to that of a married man. Persons in the employ of the Company for less than a year will receive a certifiate upon the completion of one year's service. Certificates will be issued without discrimination as to language or nationality, color or creed, irrespective of age, and without medical examination or other proof of physical condition. Payment will be made to the beneficiary designated by the employee, but if there be no designated beneficiary surviving at the death of the employee, payment will be made to (1) the widow; (2) if no widow, the children, equally; (3) if no child, the parents, equally; (4) if no parent, the brothers and sisters, equally; (5) if no brother or sister, the estate, in the order named, payment to a beneficiary first in order, excluding beneficiaries later in order. The indemnity will be paid in whole or part as soon as possible and not more than 30 days after satisfactory proof of death and identification of beneficiary. It will be paid in a lump sum or in not more than five installments, as in the judgment of the plant manager will prove the more advantageous to the beneficiary; but all installments shall be fully paid within twelve months after death. The term of the certificate will be one year, but at the end of each year, for the five years next ensuing, the intention of the Company is to issue a new certificate, increasing the amount $100 in the case of married men and $50 in the case of single men, to the end that the indemnity of married men will eventually be $1500 and the indemnity of single men $750. This indemnity is for employees of the Company only, and will therefore cease in the case of any person leaving its employ for any cause.

The motives which actuated the Company in taking the action announced may be summarized as follows:

The Company regards itself as under an obligation to its faithful and regular employees, who do its work and keep its operations going, in the same way that it is under an obligation to the stockholders whose savings and investments furnish the capital for its business. With regard to employees, the Company is concerned with the welfare, not only of the men, but of their families. Its aim is, therefore, in addition to paying them a fair living wage, as high as prevailing conditions and the competitive nature of the industry will allow, to provide safe and suitable conditions for their employment, to promote their general health and well being, to furnish aid and relief in the case of sickness and accident, and to make provision for those growing old in the service. In furtherance of this aim, the Company employs safety experts and engineers, installs safety devices, provides hospital care and medical service, administers workmen's benefit funds, and maintains an old age pension system, all under the direction of a permanent Labor and Welfare Department. In this way, while supplying the means of livelihood for them and their families, the Company hopes also to spread a feeling of contentment among its workmen, to give them a sense of security in their employment, to earn their loyalty and confidence, and to give them sound reasons for believing that the Company's interest is their interest, and thus promote a relation of mutual consideration productive of the best results for both employer and employee.

The present action of the Company in establishing a system of life indemnity for its workmen marks a further and important step in the same direction, and gives further evidence of the Company's appreciation of the individual needs of its employees and readiness to supply such needs in every feasible way. With this added proof of practical good-will before them, the Company believes that its workmen will enjoy a peace of mind and freedom of worry which can only come with the knowledge that their families or dependents at their death will not be left in want. The Company desires to cultivate a permanent force of employees, who will remain in its service from year to year, upon whose continued loyalty and industry it can rely, and who in turn can rely upon the Company to protect their interests and reward their labors. The theory of the Company is that whatever makes for a feeling of contentment and security among its workmen makes also for willingness and efficiency in their work, and gives rise to a permanent body of active and interested working aids.

The indemnity in question will be carried by the Company itself, with no charge to employees, and the cost will be taken up in the general expenses of each plant. In the case of those plants where group life insurance is now in effect under policies issued by an insurance company the policies will not be renewed on their expiration, and certificates of the Company will be issued in lieu thereof.

The certificates of indemnity above referred to will be issued as soon as the necessary details involved in the establishment of the system can be completed.

Excerpt from Circular No. 345

Effective as of Jan. 1, 1917, the American Smelting and Refining Co. (the American Smelters Securities Co. also) will issue at its own expense to each salaried employee of whatever grade, whether employed in the United States, Mexico, South America or elsewhere, who has been in the service of the Company for one year or more, a certificate of indemnity paying, in the event of death for any cause while in the employ of the Company, to his or her family or dependents a sum equivalent to one year's salary, with a maximum limit of $10,000 in the case of those receiving a larger salary.

Pig-Iron Production in 1916

The total make of pig iron in the United States in the second half of 1916, as given in *Statistical Bulletin No.* 1 of the American Iron and Steel Association, was 19,815,275 long tons, making the total for the year 39,434,797 tons, an increase of 9,518,584 tons, or 38.2%, over 1915. In the following statements compiled from the *Bulletin* all pig iron and ferroalloys are included, whether made in blast furnaces or in electric furnaces. Pig iron made with bituminous coal is included under coke pig iron. Pig iron made with mixed anthracite and coke is included in anthracite pig iron. Pig iron made with electricity is included in coke pig iron. Low-phosphorus pig iron—that is, iron running under 0.04 in phosphorus—is included in bessemer pig iron. Pig iron containing from 0.04 to 0.10% of phosphorus is classified as bessemer. The figures for 1913 and subsequent years include under basic iron a small quantity of charcoal iron of basic grade. In 1912 and prior years charcoal pig iron of basic quality was not included in the basic production. Nearly all the charcoal iron is classed as foundry pig iron. Ferrosilicon is included in foundry pig iron. Pig iron containing 7% or over of silicon is classified as ferrosilicon. Under "all other grades" are included white and mottled iron, direct castings and miscellaneous ferroalloys.

The production of pig iron by grade for two years was as follows, in long tons:

Grades	1915 Tons	1915 %	1916 Tons	1916 %
Basic	13,093,214	43.77	17,684,087	44.85
Bessemer	10,523,306	35.17	14,422,457	36.57
Foundry	4,843,899	16.19	5,553,644	14.08
Malleable	829,921	2.77	921,486	2.34
Forge	316,214	1.06	348,344	0.88
Spiegeleisen	97,885	0.33	194,002	0.49
Ferromanganese	149,521	0.50	221,532	0.56
All other	62,253	0.21	89,245	0.23
Total	29,916,213	100.00	39,434,797	100.00

The tonnage of bessemer iron increased 37% and of basic 35%. That of ferromanganese nearly doubled.

The totals for 10 years past have been as below:

1907	25,781,361	1912	29,726,937
1908	15,936,018	1913	30,966,152
1909	25,795,471	1914	23,332,244
1910	27,303,567	1915	29,916,213
1911	23,649,547	1916	39,434,797

The make for 1916 was the largest ever reported and exceeded that of the next highest year, 1913, by 8,168,645 tons.

The division of pig iron according to the fuel used was as follows in 1916: Coke, 38,844,598 tons, or 98.5%; anthracite, 217,788 tons, or 0.6%; charcoal, 372,411 tons, or 0.9%. Only two or three stacks use raw bituminous coal, and nearly all the anthracite stacks use some proportion of coke, so that coke is the fuel with which 99% of our iron is made.

Of the total iron made, 23,101,018 tons was delivered in molten condition to steel furnaces; 8,278,357 tons was machine cast; 6,584,182 tons, sand cast; 1,442,576 tons, chill cast; and 28,694 tons was direct castings.

The production for sale or for use of makers was as follows, in tons:

Grades	For Sale	For Maker's Use	Total
Basic	2,476,677	15,207,410	17,684,087
Bessemer and low-phosphorus	1,976,863	12,445,594	14,422,457
Foundry, including ferrosilicon	5,473,196	80,448	5,553,644
Malleable	921,486	.....	921,486
Forge or mill	144,615	203,729	348,344
Ferromanganese	63,166	158,366	221,532
Spiegeleisen	143,753	50,249	194,002
All other grades	53,561	35,684	89,245
Total ..... Gross tons	11,253,317	28,181,480	39,434,797

The production of the merchant furnaces which make iron for sale in the form of pig was 28.5%, and that of the stacks owned or operated by steel works 71.5% of the total.

The production by states in 1916 was as follows, in long tons:

States	1915 Tons	1915 %	1916 Tons	1916 %
Pennsylvania	12,790,668	42.75	16,506,284	41.86
Ohio	6,912,962	23.11	8,602,895	21.81
Illinois	2,447,220	8.18	3,922,512	9.95
New York, New Jersey	2,104,780	7.04	2,352,535	5.97
Alabama	2,049,453	6.85	2,762,885	7.01
Indiana, Michigan	1,986,778	6.64	2,221,708	5.63
Wisconsin, Minnesota	372,966	1.25	811,325	2.06
West Virginia, Kentucky	291,040	0.97	554,590	1.41
Mo., Iowa, Colo., Wash., Calif.	271,921	0.91	437,633	1.11
Maryland	251,548	0.84	501,452	1.27
Virginia	251,346	0.84	399,885	1.01
Tennessee	177,729	0.59	355,374	0.90
Massachusetts, Connecticut	7,802	0.03	5,719	0.01
Total	29,916,213	100.00	39,434,797	100.00

At the close of the year there were 333 furnaces in blast; the highest number at any time during the year was 344 stacks. The average output per furnace was 116,671 tons for the year.

Foreign Trade in Copper

Exports of copper from the United States in January, 1917, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrates, contents	644,784
Unrefined, etc., in bars, pigs, etc	2,273,907
Refined bars, etc	107,613,298
Old and scrap	39,260
Plates and sheets	1,832,417
Wire	3,202,105
Total	115,605,771

The weight of ore exported in January was 8015 tons; of concentrates, 651 tons.

Imports of copper into the United States in January, 1917, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrates, contents	12,916,700
Unrefined, etc., in bars, pigs, etc	45,667,596
Refined, in bars, pigs, etc	40,922
Old, etc., for remanufacture	1,156,834
Composition, copper chief value	22,513
Total	59,804,565

Actual tonnage of copper-bearing material imported in January was 25,184 tons ore, and 11,853 tons concentrates.

Mineral Production of Japan in 1916

According to the investigation of the Imperial Japanese Mining Bureau in Tokio, the production of metals and minerals from the principal mines of Japan during 1916 was as follows:

	1916	1915
Gold, kg	7,446	8,213
Silver, kg	172,194	159,261
Copper, metric tons	81,280	75,415
Pig iron, metric tons	65,014	64,897
Coal, metric tons	20,130,740	20,490,703
Sulphur, metric tons	92,677	61,405
Oil, litres	454,624,740	470,390,580

No estimates are available yet in regard to the output of zinc during 1916. The production increased from about 6000 tons in 1914 to 21,000 tons in 1915, while the capacity of the Japanese zinc refineries is said to be 45,000 tons zinc per year at the present time. It is to be remembered, however, that the zinc ore mined in Japan is only sufficient for the production of 12,000 to 15,000 tons metal per year, so that the greater part of the supply for the refineries has to be imported from abroad.

Editorials

Economic Changes by the War

It was recognized from the beginning that the war was bound to produce political and economic changes in the life of the world that would be momentous. It was foreseen that these might be so momentous and so fundamental that no one ventured to prophesy their scope, nor can that be done even yet with any safety. However, some of them have already developed; others are developing in ways that we can see.

The first great economic event was the institution of the prohibition of alcoholic drink in Russia. Respecting the economic benefit of this there is no doubt. It is probable that without this Russia would have been unable to hold out so long as she has. In France and Great Britain there has been a movement in the direction of restriction of alcoholic drink, but far less effective than in Russia. In the United States there has been a remarkable spread of prohibition legislation. It is safe to prophesy that this tendency is going to increase all over the world and that there is going to be an enormous reduction in the economic waste resulting from the use of alcohol.

The next great lesson of the war was organization. Germany's early successes were due to her superior organization, not only in the military way, but also in the industrial. The Allies had to learn from Germany's book. How they have learned we see most strikingly in Great Britain, where the policies of individualism, hardly restricted beyond the old theory of *laissez faire*, have given way to those of national collectivism. With the return of peace there will probably be much relaxation of the present rules, but that there will be a stepping back to what prevailed before the war is scarcely imaginable. We may expect to see the hand of the state continue to rest heavily upon the vital things, such as the production and distribution of coal, the regulation of shipping and the management of the railways.

The governing theory is now, and will continue to be, the promotion of economy in living. The war is the most stupendous waste that has ever been known in the history of the world. Its consequences can be minimized only by preventing all other kinds of waste, not only now but hereafter. Therefore the British government, under Lloyd George, prohibits the importation of a long list of unnecessary commodities. Domestic waste will be checked by taxation. An inconspicuous note in the recent cable news tells briefly of a new feature in Chancellor Bonar Law's new plan of revenue for the British government. He proposes, it appears, to impose heavy duties where they will be the most effective deterrents to extravagance, to make utterly impossible the earning by anybody of a profit in any business or any line of business that tempts the people to waste.

This idea is so brimful of common sense that it is no wonder it strikes the average American reader as novel, not to say revolutionary, remarks the New York *Sun*. Tax waste instead of saving; tax profligacy instead of efficiency? Shades of the income tax and the new tax on excess profits! War must have driven these Britishers mad.

Such measures are necessary to compel the mass of the people to do what they will not do by themselves. It takes a long time for new ideas, especially those of economic nature, to impregnate the minds of the people. This is one of the weaknesses of a democracy and is why the United Kingdom by the *coup d'etat* of last December was obliged to cease to be, temporarily, a democracy. But the people will learn, and that they learn by their own experience and thinking is better than to have their thinking done for them. It may turn out that the greatest work of Hoover and the Commission for Relief in Belgium is its demonstration of efficiency in administration and in the distribution of goods. The seeming paradox that they have been able to buy wheat in America, carry it to Belgium, and while suffering the interference of unparalleled difficulties, have found it possible to sell bread in Brussels more cheaply than in New York, will sooner or later produce new ideas in the minds of the people. Who so well as Hoover could solve the problem of the high cost of living in the United States and other countries?

All work resolves itself into the effort of the people of the world to live. Considering the commodities that the people must have there are four phases of the question: 1, Production; 2, Distribution; 3, Division; 4, Consumption. Great Britain has heretofore been careless, in varying degrees, in all those branches, but the war has compelled her to give heed to them, and she has done so. In production British industry is experiencing a renaissance. The matter of consumption is now receiving the careful attention of the government.

But what of the United States amid all this? It is not too much to say that collectively, nationally, we have not given thought to any of it. On the contrary, our legislation for a long period of years has been chaotic and in defiance of economic principles. In production we have excelled. In major distribution our railway companies have done wonderful things in overcoming the handicaps of our great distances. In both these branches of work, however, the people, exemplified by their state legislatures and by Congress, have done much to check and impede—by legislation to destroy the big corporations, and by special taxation. In minor distribution—meaning the transportation of goods from railway terminals, the marketing through retail stores and the final delivery to consumers—we have been derelict. The efforts to organize this branch of work have met with disfavor—not of the consumers who enjoy the benefit of it, but rather of the people as a whole in the exercise of the taxing power. In the division of commodities we have seen the development of a new kind of inequality, organized labor claiming and obtaining a larger share, while unorganized—the great majority—suffers. But it is in consumption that America is most careless. Of all the countries on the face of the globe, the United States is no-

toriously that of the greatest waste. While Europe is striving above all things to minimize waste, America is not thinking at all about the subject, but rather is pursuing a career of increased profligacy. Yet this is probably the greatest economic question to be considered.

One Per Cent. of Oil Plus or Minus

In their last quarterly report the president and managing director of the Butte & Superior Mining Co., in discussing the flotation process used by that company, the patent litigation, etc., make a positive, unequivocal and important statement as follows:

> On Dec. 11 last the Supreme Court of the United States rendered a decision in the case of Minerals Separation, Ltd., vs. Hyde, involving a patent upon the process of concentration theretofore employed in your company's mill. As a result of this decision it became necessary, in order to avoid infringement in accordance with the decree, to discontinue the use of less than 1%, on the ore, of oil in the type of flotation apparatus employed. Steps were immediately taken toward modifying operating methods and conditions to conform to the requirements of the decision by the use of 1% of oil or more. Prior to the end of December the continuous use of more than 1% of oil was adopted and has been applied regularly since that time up to date [Feb. 26, 1917]. At the time of writing this report the full plant has been running for considerably more than a month at normal tonnage and using 1% of oil or more uniformly throughout all flotation operations. The results of this modified practice have been and are satisfactory in all metallurgical respects. Some difficulties were experienced in quickly securing the increased supplies of oils required. This was due in part to the congested condition of transportation. Nevertheless an adequate supply has been maintained, and under normal operating conditions the most notable difference in operating results has been the difference in cost between the smaller quantities of oils previously used and the larger quantity of similar and suitable oils now used.

An oil-flotation process in which more than 1% of oil is used is *ipso facto* outside of the Minerals Separation patents, which recently were upheld by the Supreme Court. The line was sharply drawn at 1%. The use of less than 1% of oil is an infringement; of more than 1% it is not, this being in the eyes of both the Minerals Separation Co. and the Court a different process.

The adjudication by the Supreme Court resolved itself into the sustaining of the Minerals Separation contention that with the use of a very small quantity of oil—less than 1%—there is a certain critical point at which something different and commercially important happens, and the discovery of that constituted an invention. It was alleged, and the Court held, that when more than 1% of oil was used the same thing could not be done.

Now come the Butte & Superior people, saying that with the use of a trifle more than 1% of oil they get, if not the same thing, an equally good metallurgical result. We have heard of a similar report from the Magma mine, where copper ore is concentrated.

This is a matter of great interest, if the statements which are made so positively are correct. The questions that will first suggest themselves are: Why was not this learned earlier? Has some new invention been made? If so, what?

If with the use of 22 lb. of oil per ton the same percentage of extraction and the same grade of concentrates can be made as with 10 lb. of oil, the only commercial difference will be the cost of 12 lb. of oil on the one hand (assuming all other costs to be the same) against royalty on the other hand, no matter what may be the difference in the nature of the froths. The subject is one upon which further information is awaited with great interest.

American Smelting and Refining Co.

The 18th annual report of the American Smelting and Refining Co., covering the year ended Dec. 31, 1916, is one of the most remarkable documents ever issued by a mining and metallurgical company. Let us make haste to say that this report, like its immediate predecessor, is commendably full in its information, giving about all that a stockholder in such a company has reason to expect. The business of the company has become so complex, however, that to the engineer and statistician not many figures of value can be deduced. In order to obtain such figures it would manifestly be necessary to go back to the records of the several operating departments. Nevertheless it is interesting and instructive to summarize and illuminate some of the data that in the annual report of a company are presented with the undressed simplicity of the auditor.

The first thing that strikes us is the great diversity that this business has attained. It is the largest producer of gold, silver, lead and copper in the United States. It has become a large producer of zinc, copper sulphate, white arsenic and sulphuric acid. In 1916 it produced 1600 tons of tin and in 1917 expects to produce a good deal more than that. In 1916 it produced 612 tons of nickel. Manifestly the cargo of the "Deutschland" might have been filled from this source. There was also produced in 1916 platinum and palladium to the amount of 868 oz. Those precious metals, together with the nickel, arsenic, copper sulphate and sulphuric acid were by-products. The company has been making a specialty of byproduct recovery. It does not intend to let be wasted any of the valuable constituents of the ores that it produces and buys. Besides the metals already mentioned, it reports additional "byproduct metals" to the amount of 2835 tons in 1916 against 1115 in 1915. We wish these had been enumerated. We may imagine such things as cadmium, antimony, bismuth, selenium, thallium, but not to the total of anything like 2835 tons.

Besides being a producer of metals, the company is a manufacturer, an output of copper and brass products, litharge, sheet lead, lead pipe, and sundry alloys being reported. Even was it a manufacturer of munitions, 15,338,000 loaded cartridges being made and sold in 1916.

The basic measures of the Smelting company's business are the tons of charge smelted and of bullion refined. The latter comprises the bullion from its own smelteries plus what it gets from other smelters—like Nevada Consolidated. In 1916 the smelting of 4,789,474 tons of charge was done and the refining of 677,460 tons of bullion. The corresponding figures for 1915 were 4,153,092 and 579,080. These figures indicate that the mining industry in its relations to the A. S. & R. Co. was about 15% more active in 1916 than in 1915. It is commonly overlooked that the A. S. & R. Co. is itself an important mining company. In 1916 it produced 1,638,566 tons of ore, which was more than one-third of all the charge it smelted. In 1915 the proportion was even larger. From the mines of the company was realized $2,725,222 profit in 1916 against $1,984,977 in 1915. The receipts from mining properties in 1916 are given as $5,661,198. Apparently, therefore, the ore averaged about $3.50 per ton and the profit per ton of ore a little more than $1.50.

The Smelting company mined about one-third of all the coal it used and produced a little less than one-third of

its coke consumption. The total number of men employed in the business, exclusive of those in Mexico, was 21,073, compared with 15,556 in the previous year. The average wage per eight hours was $2.70 against $2.44, an increase of about 10%.

The net earnings of the company in 1916 were $22,152,250, compared with $13,053,304 in 1913. The figure for 1916 was arrived at after deducting $1,990,000 for depletion of ore reserves and over $2,000,000 for ordinary plant repairs and renewals. Over $5,000,000 was expended in the construction of new plant in 1916 and $6,000,000 has been set aside for further extensions. After all these deductions the company ended 1916 with a surplus of about $23,500,000, most of which was in cash and in loans secured by stock exchange collateral. There is no doubt about the excellent financial position of the company.

It is interesting to record some of the plans for the future. The company is going to enter extensively into mining and smelting in Chile, two smelteries there—the Caldera and Carrizal—having been purchased. Evidently it is also going more and more into the mining business, both in Chile and in Mexico. Most astonishing, however, is the extent to which the company is going into tin smelting and copper refining. At the end of 1916 the tin plant at Perth Amboy was producing about 600 tons of tin per month. With an addition now under construction it is hoped to produce 18,000 tons of pig tin per annum after July 1, 1917. With this extension, together with the plans of another company, it looks as if the United States will soon be producing the major part of its requirement for pig tin.

In 1916 the American Smelting and Refining Co. produced about 800,000,000 lb. of refined copper. At the end of 1916 its refineries had capacity for the production of 970,000,000 lb. per annum. Now it is officially stated that with the new construction in progress there should be a capacity for 1,300,000,000 lb. per annum soon after the middle of 1917. This will give the United States a total electrolytic capacity of about 2,800,000,000 lb. per annum, and a grand total capacity, including Lake, casting and pig copper of over 3,100,000,000 lb. Note that in 1916 the total production of refined copper in the United States was about 2,300,000,000 pounds.

Only in lead does the American Smelting and Refining Co. appear to be going backward, its total production in 1916 having been only 279,144 tons, compared with 296,986 in the previous year. The falling off was due especially to the loss of the Hercules contract. However, the Smelting company is making strenuous efforts to increase its own output of lead ore, directing its attention especially to its Missouri mines. While the production from this source at the beginning of 1916 was at the rate of approximately 42,000 tons of pig lead per annum, it has now been increased to 66,000 tons.

A most interesting feature of the report is the account of efforts for social welfare and personal safety. Excepting the United States Steel Corporation, no other company connected with the mining industry goes so extensively into the matter of social welfare of its employees.

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We understand that since the development of conditions that may cause the United States to enter into war, the admission of visitors into the metal refineries in the vicinity of New York has been discontinued.

BY THE WAY

That the trend of public opinion of the country is in favor of universal military training is shown by a compilation of recent editorial expressions on the subject by the National Security League. Since the introduction of the Chamberlain and General Staff bills in Congress made universal military training a live issue, 1193 editorial references to it have been made by the newspapers of the country. A canvass of these editorials shows that they represent 476 different papers, 270 of which are enthusiastic advocates of universal military training. Of the balance, 49, principally Socialist-Labor and religious papers, oppose this vital measure for national defense, and 157 are noncommital. Practically all the big metropolitan dailies of the country are actively promoting, through their editorial columns, the campaign of education necessary to bring about the passage of a universal military training bill by Congress.

⁂

Five consular officers have been ordered to return to their posts in Mexico and report conditions in their respective districts, according to a Washington dispatch in the New York *Times*, Mar. 18, 1917. Announcement of the decision was made at the State Department today, as follows: "The Department of State has ordered a number of consular officers to return to Mexico and report on conditions in their respective districts. John R. Silliman will return to his post at Guadalajara; Thomas Dickinson to San Luis Potosi as vice consul; Randolph Robertson to Monterey as vice consul; Thomas D. Bowman to Frontera as consul, and William E. Chapman will soon proceed to Mazatlan as consul. No passports will be issued to Americans desiring to return to Mexico until the reports of consuls upon local conditions have been received and considered, and in the meantime Americans are advised not to return to Mexico."

⁂

The state-mining scheme in the Union of South Africa, it is believed, has practically been abandoned owing to the risk inherent in mining development, and it is now expected that further development of the government areas in the Far Eastern Rand will be accomplished under the leasing system already in vogue. In testifying before the state mining commission, H. Newhouse, of the firm of A. Goerz & Co., summarized the situation succinctly in his statement that "the government should not risk ratepayers' money in mining while there were opportunities in irrigation, afforestation and other development directions to which the taxpayers' money could be devoted with certainty of gain." And again: "While the individual is quite entitled to gamble in mining when he 'has money to burn,' the state on the other hand can never have money to burn." The state-mining commission's report is expected to be "filed" and development in the Far Eastern Rand to proceed under the Transvaal Mining Leases Bill now before the Cape Town assembly. The *Financial Times* states that the passage of this bill is likely to be followed by the "long-expected introduction of Yankee capital to the Rand by the financing of the East Rand Mining Estates' Grootvlei property. Additional ground is required to round up this property.

Personals

Mark L. Requa, of San Francisco, is here.

C. W. Nichols has been elected president of the Nichols Copper Co.

Ross Hoffmann returned to Petrograd in January from Central Siberia.

F. A. Ray and **F. K. Day** have returned to Petrograd from South Russia.

F. F. Kett, who was absent from Petrograd for a month, returned in January.

R. M. Geppert arrived in Petrograd in January on his way to Siberia from London.

S. J. Speak has recently been in Siberia and expected to return to London about Mar. 1.

D. H. Browne will go to Jamaica to recuperate after his attack of grippe and neuritis.

Albert G. Wolf is at the Red Cross Hospital, Victor, Colo., suffering from a severe mine accident.

Dr. L. D. Ricketts is still seriously ill and it will probably be several months before he is at work again.

John A. Topping, chairman of the Republic Iron and Steel Co., is spending several weeks at Hot Springs, Ark.

H. W. Du Bois has returned from the meeting of the Canadian Mining Institute at Montreal, and is now at Philadelphia.

Harry D. Symmes, managing director of the Boston Creek mine, has returned to Boston Creek from a visit to Arizona.

R. H. McDonald, formerly captain of the Alexandria mine (Chisholm), is superintendent of the Feigh mine (Ironton).

C. H. Scheuer, chief engineer Oliver Iron Mining Co., Fayal district, Eveleth, Minn., spent two days on the Cuyuna range.

F. G. Lasin, of Detroit left New York Mar. 14 for Colorado, Utah and Arizona and will return to Michigan about Apr. 10.

Howland Bancroft, of Denver, is making examinations in the Oatman district of Arizona. He will return to Denver early in April.

W. E. Fenwick, superintendent of the Francisco Mining Co., Los Acostas, Pinar del Rio, Cuba, has been in the United States for a few weeks.

Harrison W. Craver has resigned as chief librarian of the Carnegie Library, Pittsburgh, and will become director of the library of the United Engineering Societies, New York.

J. C. Dick, in partnership with C. T. Van Winkle, has opened offices for the practice of mining and metallurgical engineering in Scott Building, Salt Lake City, Utah.

H. H. Nicholson has finished the examination of the Black Bear mine at Grass Valley and returned to the Plinco mine, at Doyle, Calif., for which he is consulting engineer.

N. M. Muir has returned to San Francisco from Jarbidge, Nev., where he has had charge for 8 months of the development of the Hanford properties recently taken over by the Elkoro Mines Co.

Sir Robert Hadfield has offered, through the Council of the Institution of Mechanical Engineers (British), £200 to provide a prize or prizes for a new and accurate method of determining the hardness of metals.

E. C. Reeder has been appointed manager of the Chicago branch of the Clyde Iron Works, of Duluth, Minn., with offices at 900 Fisher Building. He succeeds E. S. Quinn, who is now in charge of the New York office.

C. H. Hunt, for several years chief engineer of the William Tod Co., Youngstown, Ohio, has resigned to accept the position of chief constructing engineer for the Phillips Sheet and Tin Plate Co., Weirton, W. Va., effective Mar. 15.

Dr. John H. Banks, of the late firm of Ricketts & Banks, announces that his son, Harold P. Banks, has been taken into partnership. The address of the new firm of John H. Banks & Son will remain at 61 Broadway, New York.

Dr. R. B. Moore, of the Golden branch of the U. S. Bureau of Mines, is chairman of the Colorado section of the Naval Consulting Board. He delivered an address at a largely attended luncheon in Denver, Feb. 28, on "What is Industrial Preparedness?"

H. J. Rahilly of the United States Bureau of Mines has been conducting examinations during the week for Butte members of the mine rescue and first-aid classes which have been instructed by J. L. Boardman of the Anaconda Copper Mining Co.

T. M. Schumacher has been elected president of the El Paso and Southwestern R.R. Mr. Schumacher has been in charge of the operations of the Phelps, Dodge railroads for several years. The change is part of the new operating policy of the Phelps, Dodge company.

H. H. Stout has been made assistant to the president, C. W. Nichols, of the Nichols Copper Co., and has been succeeded as metallurgical manager at the works by O. C. Martin.

Lawrence H. Stone has been promoted to the office of superintendent of the Thomas Iron Co.'s Richard mine to succeed Albert L. Lobb. Mr. Lobb was connected with the iron company for 32 years. He started as a miner and advanced slowly until he was made assistant to the superintendent, James Arthur, in 1910.

A. E. Wheeler, formerly superintendent of the Great Falls smeltery, of the Anaconda Copper Mining Co., but for the last three years in charge of the Belgian operations in the Congo district, Africa, is visiting in Montana, inspecting the new features at the Washoe and Great Falls smelters that have been introduced during his absence.

Frederick Laist, manager of the Washoe works of the Anaconda Copper Mining Co., left Anaconda Mar. 10 for New York, whence he will sail for Chile, S. A., by way of Panama to inspect properties at Potrerillos, now being explored by the Anaconda company. He is accompanied by William Wraith, of the Tooele Smeltery in Utah. They expect to be absent about three months.

Francis Bird Dutton, formerly general manager of the Pennsylvania Steel Co.'s Lebanon plant, has associated himself with the American Grondal Co., 120 Broadway, New York, and will have charge of all its technical work. This embodies the Grondal wet magnetic separator, the Grondal briquetting kiln and, under certain circumstances, the Greenawalt sintering process. The Pennsylvania Steel Co. operated a concentrating mill at Lebanon, using the Grondal separators. Mr. Dutton is not only familiar with this operation but with the other magnetic concentration operations in the country.

Obituary

L. C. Winn, of New York, and Bert Seigel, of Pittsburgh, are reported to have been killed by Mexican bandits, said to be Villistas, at Magistral, Durango, Mexico. Both were employees of the National Mines and Smelters Co., of Pittsburgh.

Frederick Rowland Hazard, president of the Solvay Process Co., Syracuse, N. Y., and president of the Syracuse Trust Co. and a director of many other concerns, died at Syracuse Feb. 27. He was born at Peacedale, R. I., and graduated from Brown University in 1881. He was a presidential elector last year.

Societies

Society of Chemical Industry held a meeting of the New York section on Mar. 23, at the Chemists Building, 50 E. 41st St., New York. Papers were read on "Food Fads," by Prof. Lafayette Mendel, of Yale University, and "Food Values," by Dr. Graham Lusk, Cornell University.

American Society of Mechanical Engineers has changed the date of its spring meeting, which will be held at Cincinnati, May 21 to 24, 1917. A feature of the meeting will be a joint session on Tuesday, May 22, with the National Machine Tool Builders' Association. This will be in charge of the Cincinnati local committee and a committee representing the Machine Tool Builders' Association. Papers will be presented on employees' service work and industrial education, as developed in Cincinnati. The change in the date for the opening of the meeting was made in order to permit of this joint session. Another important session will be devoted to a discussion of problems relating to the manufacture of munitions. The papers will treat of topics such as financing, organizing, inspecting, specifications, materials, limits, gages, special machines, designing for quantity manufacture, training the working force, etc. All who have had experience in the manufacture of munitions are invited to contribute brief discussions. Sessions will also be held by the subcommittees on gas power and on machine-shop practice, and there will be at least one session devoted to miscellaneous papers. At the gas-power session papers will be presented on recent developments in high-speed gasoline engines with special reference to automobile and aviation service. The machine-shop session will be of particular interest to those engaged in the manufacture or use of machine tools.

Industrial News

Bacharach Industrial Instrument Co. has removed into larger quarters at 422 First Ave., Pittsburgh, Penn.

Pennsylvania Smelting Co. will have its Pittsburgh office in the First National Bank Building, Pittsburgh, after Mar. 26.

Hamilton & Hansell, 17 Battery Pl., New York City, have sold a 1-ton Rennerfelt electric furnace to the Oklahoma Iron Works, Tulsa, Okla., for installation in its new steel foundry. The new 1½-ton Rennerfelt furnace, recently installed at the plant of the Parsons Co., Newton, Iowa, is now in operation.

Evinrude Motor Co., of Milwaukee, Wis., manufacturers of rowboat and canoe motors, has increased its capital stock from $350,000 to $600,000 to engage the manufacture of internal combustion, heavy oil engines. Construction of a large modern plant will be begun at once, the site, which will be in the city, being about definitely decided upon.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Agitation—Automatic Controlling System for Continuous Agitation and Transfer Systems for Treatment of Ores. John Wm. Bucher and Randall P. Akins, Denver, Colo., assignors to Colorado Iron Works Co., Denver, Colo. (U. S. No. 1,219,240; Mar. 13, 1917.)

Classification—Ore Classifying and Separating Process. George C. Hackstaff and George B. Holden, Denver, Colo. (U. S. No. 1,219,408; Mar. 13, 1917.)

Classification—Method and Apparatus for Separating Magnetic Ores. Joseph Weatherby, New Cumberland, Penn,. assignor, by direct and mesne assignments, to Electric Ore Separator Co., New Cumberland, Penn. (U. S. No. 1,218,916; Mar. 13, 1917.)

Concentrator. Harley L. Sherwood, Oregon City, Ore. (U. S. No. 1,219,048; Mar. 13, 1917.)

Concentrating—Ore Concentrating Apparatus. George W. Burnhart, Denver, Colo. (U. S. No. 1,219,977; Mar. 13, 1917.)

Concentrating — Ore Concentrating Apparatus. John Mickelson, Anaconda, Mont. (U. S. No. 1,219,128; Mar. 13, 1917.)

Concentrating—Method and Apparatus for Concentrating Ore. Harry M. Dunn, Hurley, N. M. (U. S. No. 1,219,089; Mar. 13, 1917.)

Drilling—Well Drilling Bit. George Lorenzo Lane, Williamstown, W. Va. (U. S. No. 1,218,671; Mar. 13, 1917.)

Electric Furnace. Hector de Nolly, St. Chamond, France, assignor to Société Electro-Métallurgique De St. Béron, Lyon. France. (U. S. No. 1,216,961; Feb. 20, 1917.)

Furnace. Malcolm U. Wikstrom, Charleroi, Penn., assignor to Pittsburgh Steel Products Co., Pittsburgh, Penn. (U. S. No. 1,217,251; Feb. 27, 1917.)

Magnetic Separator—Automatic Magnetic Separator for Mills. Henry O. Little, Bridgewater, Mass. (U. S. No. 1,217,613; Feb. 27, 1917.)

Mine Cars—Safety Stop for Mine Cars. William D. Moon, Blocton, Ala., assignor of one-half to Clyde W. Lowrey, Blocton, Ala. (U. S. No. 1,217,620; Feb. 27, 1917.)

Mine Signal—Pull Switch for Electric Mine Signals. Carl Clausen, Bisbee, Ariz. (U. S. No. 1,217,707; Feb. 27, 1917.)

Ore Separator. Daniel W. Shepherd, Rupert, Idaho. (U. S. No. 1,218,809; Mar. 13, 1917.)

Potash—Process of Extracting Potassium from Minerals. Henry Blumenberg, Los Angeles, Calif., assignor to Elliott B. Mapel, trustee, New York. (U. S. No. 1,214,003; Jan. 30, 1917.)

Pump—Deep Well Pump. William B. Hewitt, Holyoke, Mass., assignor, by mesne assignments, to Worthington Pump and Machinery Corporation, New York. (U. S. No. 1,219,307; Mar. 13, 1917.)

Pump—Working Head for Deep Well Pumps. John T. S. Brown, Jr., Prospect, Ky. (U. S. No. 1,218,626; Mar. 13, 1917.)

Roasting and Magnetic Separation.—Process of Treating Iron Ores. Thomas S. Maffitt, St. Louis, Mo., assignor, by mesne assignments, to Mississippi Valley Iron Co., Wilmington, Del. (U. S. No. 1,219,338; Mar. 13, 1917.)

Sulphur Byproducts—Process for the Utilization of Waste Sulphite Liquor. Adolph D. Fest, Chicago, Ill. (U. S. No. 1,218,638; Mar. 13, 1917.)

Sulphuric Acid—Apparatus for Effecting the Continuous Concentration of Sulphuric Acid. Sylvain Dreyfus, Denton, near Manchester, Lancaster, England. (U. S. No. 1,217,577; Feb. 27, 1917.)

Sulphuric Acid—Process of Producing Sulphuric Acid. Peder Farup, Glöshaugen, near Trondhjem, Norway, assignor to Det norske Aktieselskab for elektrokemisk Industri, Christiania, Norway. (U. S. No. 1,219,277; Mar. 13, 1917.)

Zinc—Electric Zinc Distilling Furnace. John Thomson, New York, and Francis A. J. Fitz Gerald, Niagara Falls, N. Y., assignors to John Thomson Press Co., Jersey City. (U. S. No. 1,219,194; Mar. 13, 1917.)

Zinc—Condenser in the Metallurgy of Zinc. John Thomson, New York. and Francis A. J. Fitz Gerald, Niagara Falls, N. Y., assignors to John Thomson Press Co., Jersey City. (U. S. No. 1,219,193; Mar. 13, 1917.)

Editorial Correspondence

SAN FRANCISCO—Mar. 14

Increased Chemical Production in California is forecasted in the application, recently granted to the Great Western Electro-Chemical Co. by the California department of corporations, for permission to sell an additional 4000 shares of preferred stock and to issue 3400 shares of common stock to net $400,000, for installing additional equipment and enlarging plant for the production of caustic soda and chlorine and the manufacture of other chemical products. In the last year $600,000 has been invested. The plant is situated at Pittsburg, a manufacturing town on the Oakland, Antioch & Eastern Ry., in Contra Costa County.

Industrial Accident Commission of California has issued its annual report for the period from July 1, 1915, to June 30, 1916. The outstanding features of the work of the mining division are: (1) Adoption of mine-safety rules; (2) inauguration of a safety campaign among mine operators and miners; (3) inspection of a total of 355 mines, quarries and dredges; (4) training of 711 miners in first aid to the injured. As in the previous year, the work of the division was carried on in coöperation with the Federal government and mine inspection under the supervision of a mining engineer of the U. S. Bureau of Mines. Up to the end of the fiscal year no difficulties were met in the administration of the safety rules, which became effective Jan. 1, 1916. The first half of the year the work was under the supervision of H. M. Wolflin, who began the work of investigation Jan. 1, 1914. Mr. Wolflin was succeeded by Edwin Higgins on Jan. 1, 1916, who was given the title of chief inspector. In July, 1915, G. Chester Brown and J. W. Gebb were appointed deputy mine inspectors and in September F. L. Lowell was appointed. During the first half of the fiscal year the deputies inspected 200 mines which employed a total of 8000 men; more than 1400 suggestions for safety resulted. As inspections of this period were under the existing laws, the work of the second half, under the new safety rules, was necessarily more thoroughly systematized and the inspections were consequently more complete. In this period 155 mines were inspected and 15 fatal accidents investigated and reported upon. The safety campaign inaugurated early in 1916 embraced the issuance of bulletins on safety and efficiency in mining and the organization of the Safety Bear Club. Up to the end of the year 285 blueprints and photostat copies of sketches and 300 clippings relating to safety and efficiency were mailed to operators of mines in the state. By the end of the year more than 5000 miners had become members of the Safety Bear Club and four of the Safety Bear letters had been mailed to all members. The interest taken by the miners themselves in the practice of safety rules was evidenced by their active participation in the affairs of the club, the effective results of which have been highly appreciated by mine owners and operators. First-aid and rescue training was given in California in the year by George W. Riggs, S. C. Dickinson and Joseph Woods of the Bureau of Mines and by Messrs. Brown and Lowell, deputy mine inspectors. The complete course of first-aid training was given 281 miners and the partial course to 430; mine-rescue training to 15 miners, this small number being accounted for by the fact that oxygen-breathing apparatus was not installed at the mines until near the end of the fiscal year; the installation of such apparatus was then applied to mines employing more than 30 men on one shift.

BUTTE—Mar. 16

Activity in Jardine District is attracting attention. After having been idle for the last 11 years, the district is experiencing a revival that bids fair to assume considerable proportions. The Jardine Gold Mining and Milling Co. is doing considerable development work and the Butte-Jardine Metal Mines company is working a force of miners in a crosscut tunnel to tap several large veins that are exposed on the surface. This company owns six claims, adjoining the property of the Jardine Gold. Jardine is a noted gold and tungsten district, having a record output of more than $3,000,000. Some rich samples of tungsten ore have recently been brought to Butte from the district, which lies along the north boundary of Yellowstone Park.

Accidents at Butte Mines during the past week were remarkably few considering the possibilities in connection with the Minnie Healy fire and the gas in certain portions of the West Colusa, Tramway and Leonard mines. There were three deaths, however, from accidents of the more usual sort. Patrick Byrne, a miner at the Anaconda company's Steward mine, was killed Mar. 9 by a fall of ground that came through an opening in the lagging on the 2300 level, inflicting a gash that almost decapitated him. William Harty, a miner at the North Butte company's Speculator mine, was killed Mar. 13 by being struck by a falling rock that came bouncing down the shaft while he was standing on the upper deck of the cage at the 600-ft. level. Mike Rozic, a muleskinner at the East Butte company's Pittsmont mine, was killed Mar. 13 by being caught between a tram car and a post in the haulage drift on the 1200 level. At the Washoe works in Anaconda, Louis Lane was killed Mar. 11 by being run over by a calcine car from which he was thrown when a switch train ran into the string of calcine cars.

Tuolumne's Annual Meeting held in Butte, Mar. 12, was an event of widespread interest here. Of the 2200 stockholders of the company, a large number resfde in the Butte district and have been keeping in close personal touch with the operations of the company. Last year and the year before that, the annual meetings of the Tuolumne company were marked by most bitter fights between the minority and majority interests. The meeting this year was in strong contrast. Not a word of criticism was to be heard. Every stockholder was not only satisfied but jubilant over the results and most enthusiastic praise for the management was expressed. The reason for this is well understood in mining circles. During the last year Tuolumne acquired control of the Colusa-Leonard and the Butte Main Range properties and in the first few weeks of development opened up what appears to be one of the largest orebodies ever found in the district. At the meeting of the stockholders the following directors were elected for the ensuing year; Edward Hickey, Paul Gow, James A. Canty, Edward J. Hickey, John Harrington, T. E. Murray of St. Paul and William Jahn of Milwaukee. The action of the directors in offering to exchange one share of Tuolumne stock for three shares of Butte Main Range and to exchange one share of Tuolumne stock for four shares of Colusa-Leonard stock is another step toward the complete consolidation of the three companies into the Tuolumne. The offer of exchange is close to the market value of the stocks concerned. Tuolumne has been selling between $1.62½@2.25 per share in the last month. Colusa-Leonard stock has been selling between 40@55c. per share and Butte Main Range has been selling at from 70@80c. a share. The annual report of the Tuolumne company shows that on Dec. 31, 1916, the cash in banks and ores in process of settlement amounted to $186,450; a year ago the balance was $21,645. Manager Gow recommended that the Sinbad shaft be sunk an additional 400 ft. and that it be enlarged to three compartments from the 700 level upward. In addition to other improvements planned, a new hoisting equipment will be required at the Main Range property. A 2600-cu.ft. electric-driven compressor has already been ordered and the boiler plant is being enlarged to 600 hp.

DENVER—Mar. 16

Colorado School of Mines has joined the preparedness movement of the colleges. Alumni and students have become interested in the work that is believed will prove especially useful to the Government inasmuch as the school is in position to report reliably upon the West's mineral resources. Prof. Harry J. Wolf is adjutant in charge of the work.

Shortage of Miners, according to Fred Carroll, state commissioner of mines, is preventing Colorado from making much larger productions in all the metals. Fully 2500 miners could be put to work immediately, he believes. On the Western slope, classes are being conducted to give instruction in mining to laborers, while farmers from Kansas are being induced to learn mining. Demand for men is so strong in the Leadville district that the threat of strike for higher wages made four months ago is being revived.

SALT LAKE CITY—Mar. 16

Laws Affecting Mining, which were passed by the twelfth session of the Utah legislature, just ended, were as follows: A constitutional amendment providing for taxing metal mines at a multiple or submultiple of their net proceeds; other mines, not metal, at their full value; metal mines in addition are taxed at $5 an acre and at full value of improvements; also if the ground is used for purposes other than mining it shall be taxed in addition; this amendment passed the legislature, but must be voted on by the people in November, 1918. An occupation tax on mines and a workman's compensation bill; the occupational tax on mines provides for the collection of $1 a year for every employee, laborers excluded, and for the year 1917, taxes the mines 3% of their net proceeds, and 2% of the net proceeds thereafter; this is in addition to the tax on one times the net proceeds now imposed, so that in 1917, the mines will be paying on about four times their net proceeds—payable in December, 1918. The state board of equalization, which is a body of four members appointed by the governor, is given power to impose and collect the tax. Mining companies which are delinquent may be obliged to pay a fine of 5% and interest at the rate of 12%, for not reporting their proceeds, or the payment of the tax. Of funds collected under this act seven-sixteenths are to be applied to the state school fund, and nine-sixteenths to the general fund. Twenty-eight per cent. of the amount apportioned to the general fund goes to the University of Utah and the Utah Agricultural College. The state levy will be increased to the constitutional limit of five mills.

"Net Proceeds" of Utah Mines amount at present to approximately $40,000,000 a year, and the taxes now arranged will net almost $1,200,000 during the next two years. The occupation tax is to be levied on all persons and corporations carrying on the business of mining, whether as owner or lessee, etc., and whether the mines are metallic or non-metallic or placer. Operations amounting to less than $500 a year are exempted from the occupation tax. All persons are required to make out statements, beginning with the year 1918, containing all of the data required by the law, to be furnished on or before the second Monday in February each year. The statement must contain a true account of actual expenditures of money and labor in extracting and transporting mineral and conversion into money during the year, allowance to be made for all money expended for labor, machinery and supplies, but deduction shall not include salaries of any officer or person not actually engaged in the work of the mine or personally superintending the same. The occupational tax bill is a law, but may be unconstitutional. There was much opposition to the provision for taxing mines at three times their net proceeds on the ground that the net proceeds of Utah mines being $40,000,000 a year and that approximately $600,000 a year or $1,200,000 for the next two years would be collected through the tax—that this was too great an amount, and that many industries throughout the state were as well able to pay the income tax as the mines. It has also been held by competent legal authority—former U. S. Senator J. L. Rawlins, who was retained by the legislature as its legal adviser, and by others—that according to the state constitution no such power exists in the legislature as to tax at three times the net proceeds. Sec. 3, Art. 13, of the constitution provides for "uniform and equal rate of assessment and taxation on all property in the state." It should be mentioned that the occupational tax and the amendment proposed providing for taxing mines on a multiple or submultiple of the net proceeds were both administration measures prepared in the office of the attorney general. These were introduced in their present form, 11 hours and two hours, respectively, before the legislature adjourned and were railroaded through without any semblance of a hearing, or any effort to give the interests affected an opportunity to be heard. The proposition previously agreed upon, by the legislative committees and representatives of the mining interests regarding mine taxation at a meeting held Mar. 4, and called at the request of the governor, was rejected by the governor, and the measures agreed upon at that conference were never introduced. The occupational tax is regarded here as distinctly class legislation. No attempt has ever been made before to impose a similar tax on any other indutsry.

WALLACE, IDAHO—Mar. 12

Wages Advanced Voluntarily in Cœur d'Alene mines as a result of a meeting in Wallace by representatives of the principal producing companies. Wages of all employees under the grade of manager were increased 25c. per shift so long as the price of lead for the preceding month averages above 7½c. per lb., based on the quotation of the Engineering and Mining Journal. The previous voluntary advance became effective on Feb. 1, 1916, and provided for an increase of 25c. per shift for every 0.5c. increase in the price of lead above 5c. per lb., but stopped at 6½c., making the total increase or bonus $1 per shift. The advance just made will make a total increase of $1.25 per shift, which applied to miners means $4.75 per day. It is estimated that over 5000 employees are affected by the raise.

Suit Against Federal Mining and Smelting Co. has been instituted by the Star Mining Co. for ore valued at upward of $500,000 alleged to have been wrongfully extracted from the ground

of plaintiff. A permanent injunction restraining the Federal from further trespassing is also asked. The action is brought in the United States court for the district of Idaho, and argument is being heard today by Judge Deitrich at Boise on the question of issuing a temporary restraining order against the Federal company until the issues have been finally determined. The complaint is supported by lengthy affidavits by E. H. Moffit, president and manager of the Star Mining Co.; Stanly A. Easton, manager of the Bunker Hill & Sullivan Mining & Concentrating Co., and Rush J. White, mining engineer, formerly chief engineer for the Federal company. The Star property joins the Morning mine, the Federal, on the east, and it is alleged that the trespass consists of drifts run from the workings of the Morning into the Star ground on eight levels, beginning with the 800, or main-adit level, and extending to the 1850, the deepest level in the mine. It is shown that the Evening Star and Morning claims have a common end line, and it is alleged that these drifts extend west beyond the common end line for distances ranging from 300 to 1200 ft., and that on all but two of these levels stopes have been opened on Star ground and ore extracted to the value of more than $500,000, and the engineers estimate that 1,000,000 tons of ore were developed. The Star was under option to the Federal company in 1914. The Star company has been inactive for several years, but it is controlled by strong financial interests, and it is known that expert engineers and geologists of national fame have been engaged. From the standpoint of tangible ore involved, it is believed that this is the most important litigation in the history of the Cœur d'Alene district. No intimation has been made of the line of defense that will be made by the Federal, but it is presumed it will be contended that the apex of the vein is in the Iron Crown and Grouse claims, two of the Morning group lying south of and adjoining the Evening Star and Mary J. Fraction.

OATMAN, ARIZ.—Mar. 15

United Eastern Mill, since starting operations Jan. 4, has treated an average of more than 200 tons of ore daily with a net realization of $23.30 a ton. Mill is now treating 220 to 235 tons a day and shipping $150,000 to $160,000 in bullion monthly. The orebody being mined is 30 to 48 ft. in width and has been opened for length of 700 ft. on four levels to depth 665 ft. Shaft should intersect vein on dip at 950 ft. First discovery of ore in the United Eastern mine was made two years ago today. Machinery is arriving for addition to Tom Reed cyanide mill and new unit, which will increase capacity to about 300 tons daily, will be completed within 75 days. This company has practically developed a new mine in its Aztec workings 1 mile east of the main workings. Main workings on Ben Harrison claim have reached a depth of 1400 ft. and are in ore all the way from a depth of 250 ft.

IRONTON, MINN.—MAR. 15

Efficiency of Mining Operations in all state-owned mines of Minnesota is to be the subject of a quasi-Federal investigation, arrangements for which have been made by State Auditor Preus, through the coöperation of Van H. Manning, director of the U. S. Bureau of Mines. The investigation is to determine whether in the state-owned mines all requirements as described in the state leases are being met and if conservation policies are being followed. The leases on state-owned mineral lands call for the removal of all merchantable ore according to the best mining methods.

JOPLIN, MO.—Mar. 17

Deficiency of Mine Labor now restricts the output of Joplin. Stronger gas and additional electric current have created an increased demand for mine labor, especially shovelers, and, unless more labor can be secured, it will materially handicap the output. The mechanical equipment of the district is equal to 12,000 tons per week, while the human equipment is equal only to approximately 8400 tons weekly. Should additional labor be slow coming, with a probable strong demand for ore, and high prices prevailing, it is a fair surmise that producers will bid for labor until a serious labor situation is developed by or before midsummer. The active demand for blende the last four weeks has taken up a large part of the 14,000-ton reserve on hand the first of the year, leaving around 3900 tons of unsold ore, mostly calamine.

Several Mining Deals of interest marked the week just passed, the considerations totaling well over half a million dollars. The largest was that of a 243-acre lease between Commerce, Okla., and the camp of Picher, 4 miles to the northeast, for $300,000. Temple Chapman, Grenville Chapman and O. Longacre, of Joplin, and Samuel Sullivan, of Miami, Okla., were the owners of this lease; the buyers were J. R. Cole and associates, of Tulsa, already heavily interested in the field, and also large oil operators. Another important sale was that of the B. L. & G. Co.'s 20-acre lease in the same vicinity to S. Y. Ramage and associates, of Oil City, Penn., $125,000 being paid for seven-eighths interest in the property. This is a 20% lease, and the developments include only 15 drill holes and a shaft sunk 190 ft into ore. The company plans constructing a mill at once. It is a record price for a lease with so little development. L. P. Buchanan, of Joplin, sold a one-fifth interest in the Blue Mound Mining Co.'s property, in Kansas just north of Picher, for $100,000; the mill on this property has been operating only a few months and is now making nearly 300 tons of concentrates weekly, being one of the big producers of the field; the property was developed by William Kenefick and associates. Early in the week the Boomerang Mining Co. sold its 40-acre lease east of Picher for $65,000. Another lease of 40 acres was sold by Frank B. Johnson, an Oklahoma City banker, for $50,000, and several other smaller sales are reported. The price of leases in this section of the district is steadily advancing, and localities considered a few years ago as completely out of the field of mineralization are now being drilled and being proved to carry ore deposits in many instances. The Central Lead and Zinc Co., which has a new concentrating plant almost ready to operate about 1 mile west of Picher, is reported to have refused $400,000 for its property, although it has made no production yet.

TORONTO—Mar. 17

Wage Question in the Porcupine and Cobalt districts appears to be in a fair way of being amicably adjusted. It is stated that the men have decided not to press their claim for a recognition of the Western Federation of Miners, which would be firmly resisted by the operators, but ask for an all-around increase of 50c. per day for both underground and surface workers. The mine managers of Cobalt offered a 25c. bonus as a compromise, and the general opinion is that a strike will be averted, though nothing will be definitely known until next week when the union is expected to take action.

Smoke Damage Suits, brought by J. H. Clary and J. Ostroski, farmers of the Sudbury district, against the Mond Nickel Co. on the ground that the fumes from the smelting plant destroyed vegetation and rendered their farms unworkable, which were in progress in the High Court in Toronto, came to a sudden close on Mar. 9. It was pleaded for the defence that a stoppage of the operations of the company at present would cut off the supply of nickel for the armament manufacturers and retard the prosecution of the war. The plaintiffs accepted this view and withdrew their claims for damages and applications for an injunction for patriotic reasons.

The Mining News

ALASKA

ALASKA GASTINEAU (Juneau) — Milled in February 150,000 tons averaging $1.35; extraction 83%; loss in tailings 22c. per ton. In January, milled 173,300 tons averaging $1.24 per ton.

ARIZONA

Cochise County

COPPER QUEEN (Douglas)—Steps taken to increase capitalization from $2,000,000 to $50,000,000 to correspond with growth and surplus. Also contemplate making this the operating company for all Phelps, Dodge & Co. subsidiaries.

TWO PEAKS (Turner)—Development resumed in Buck tunnel; from 200-ft. point, crosscut started easterly encountered ore at 14 ft.; still in ore at 26 ft. New tunnel will be started on White Oak claim and run northeasterly to tap orebody 300 ft. deeper.

Gila County

MIAMI (Miami)—February flotation operations reported to the court as follows: Tons of feed, 113,639; of concentrates, 1361; copper tenor of feed, 1.18%; of concentrates, 43.426%; of tails, 0.668%.

OLD DOMINION (Globe)—New flotation unit being added to mill; also 40-ft. Dorr thickener for dewatering slimes before flotation; about one car of flotation concentrates sent to International smeltery daily; jig and table concentrates treated in Old Dominion smeltery. Kingdon shaft being sunk to 1950 level.

Mohave County

TELLURIDE (Oatman)—Work resumed in this property; some lateral exploration is to be done on the 500 level and shaft deepened to the 600-ft. level.

BIG JIM (Oatman)—This property, adjoining the Aztec workings of the Tom Reed on west has reached the vein on the 600 level and is crosscutting. About 400 ft. between workings of two properties. Vein averages 30 ft. in width and is said to be all ore, with streaks of high-grade at intervals along foot-wall.

WESTERN ORE CONCENTRATION CO. (Chloride)—Excavations completed for 250-ton flotation mill. Milling equipment will include: A 9 x 15-in. Blake crusher; 14 x 30-in. Reliance roll; 19-ft. Hancock jig; another 14 x 30-in. Reliance roll; five No. 3 Wilfley tables; Marcy ball mill; five No. 5 Wilfleys; Kohlberg & Kraut flotation equipment. Frank E. Steffy, engineer.

Pima County

MILE WIDE COPPER (Tucson)—On 200 level, crosscut orebody for 16 ft.; continuing 20 ft. farther, company reports entering another body of nearly solid chalcopyrite for 8 ft. C. E. Visel, superintendent.

TUCSON-ARIZONA (Tucson) — New mining equipment installed and sinking of permanent shaft at east end of property begun. West shaft at 70 ft. depth cut 4 ft. of 6% copper ore; one car shipped therefrom. Asher Cowan, superintendent.

NEW CORNELIA (Ajo)—Mar. 1, progress report on new 5000-ton leaching plant shows: Mining department equipped to deliver 5000 tons per day; primary crushing plant ready except a few chutes; 10,000-ton storage bin for coarse-crushed ore nearly finished. In leaching plant proper, Hulett excavator about 60% complete; asphalt paving between leaching tanks nearly finished; steel structure to carry solution pipes and centrifugal pumps about completed; two solution-storage tanks are lead lined, and wood floor laid for the other two; three of the four 22-ft. Wedge roasters erected and brickwork being laid in the first two; all lead anodes made and about half of them placed in tanks. In power plant, both 7500-kw. turbo-generators have been tested; electrical work about 90% finished. At townsite, store building will be ready for occupancy within a month; hospital excavation about completed.

Yavapai County

UNITED VERDE EXTENSION (Jerome)—Grading contract let to Fleming & Stitzer for standard-gage extension of Verde Valley railroad from the terminal at Clarkdale to the Hopkins ranch, the site of the new smelting plant.

JEROME VERDE (Jerome)—"Important developments" recently rumored seem to have been based on encountering in the Columbia shaft, at a depth of about 950 ft., a body of jasper and iron; the jasper contained magnetite and specimen hunters looking over the dumps mistook the magnetite for chalcocite. Shaft 985 ft. deep now and in April when it reaches 1050 ft., lateral exploration will be started. J. B. Harper, superintendent.

JEROME DAISY (Jerome)—A 25-hp. hoist installed and shaft sinking will be resumed; shaft already 80 ft. deep.

CALIFORNIA

Amador County

CONSOLIDATED AMADOR (Sutter Creek)—New motors installed and as soon as wiring is completed the new hoist will be put in commission. Motors are said to be largest in Amador County; rated at 300 hp. and weigh 5 tons. Last storm increased amount of water to be handled by the pumps, one of the sinking pumps having been necessarily raised to a higher level.

CENTRAL EUREKA (Sutter Creek)—Vein, recently disclosed on 2500 level, has been drifted on for 250 ft., average assay $6 per ton; large amount of filling had been done on this level as ground had not been considered favorable, but opening will now be made from face of drift to the shaft. Since deepening shaft to 3400 ft., crosscut was driven above sump and ore of fair value disclosed.

Inyo County

SALINE VALLEY SALT CO. (Keeler)—Merger with Owens Valley Salt Co. contemplated. Tramway idle during heavy storms, but is expected to be put in commission again soon. Increase of grinding plant expected to provide for 75 tons per day; now handling about 30 tons. About

6000 tons of crude salt at the works ready for treatment. White Smith, president, said be in control.

JACOBY (Big Pine via Zurich)—Shipping to Garfield smeltery. In 1880 mine was large gold producer but at depth developed copper ore without gold. Oasis Copper Corporation in March, 1916, after sinking shallow shaft, began shipping ore; five carloads in initial shipment netted $1500 a car. First shipment was by way of Coaldale, Nev., but cost of wagon haul was reduced by hauling 37 mi. to Zurich which is the railroad station for Big Pine. Property is in foothills of White Mountains. Vein cut at depth of 90 ft. by a 400-ft. tunnel. Deep shaft to be sunk to test continuity of orebody which is lenticular. W. J. Neil, manager.

Nevada County

GOLDEN CENTER (Grass Valley)—Doubling of 10-stamp mill, nearing completion. Oreshoot cut on 900 level; flow of water will require installation of Cameron turbine pump.

ALLISON RANCH (Grass Valley)—Electric hoist ready for connection with the motors; two electric pumps being installed; compressor nearly ready. About six weeks will be occupied in unwatering. Five of the cyanide tanks are in place. C. A. Brockington, manager.

EMPIRE (Grass Valley)—Twelfth horizontal plunger-type pump will be installed immediately. Pump weighs 4600 lb. and will be driven by 200-hp. motor; capacity of 800 gal. per min. for 1000-ft. lift. Will be installed in the Pennsylvania workings to take care of water on 1400 level.

Orange County

SOUTHERN CALIFORNIA COAL MINING CO. (Orange)—Permitted to issue 15,000 shares to S. M. Craddick in part payment for property situated 9 miles east of Orange. Also permitted to sell 35,000 shares to pay balance on purchase price and to install equipment to operate mine. Some coal is said to have been mined prior to 1895.

Placer County

EXCELSIOR (Forest Hill)—Heavy snow, weighting electric-power line crossing 1000-ft. cañon, put line out of commission. Short-circuiting caused burning out of machinery and new equipment will have to be taken up narrow heavy-grade trail to power house at Cache Rock on middle fork of American River.

Plumas County

IRON DYKE (Taylorsville)—Reported that large deposit of high-grade copper ore has been disclosed in development of the U. S. Smelting Refining and Mining Exploration Co. Compressor recently installed; 20 men employed. Tunnel being driven to crosscut Cemetery ridge. High-grade copper ore also reported disclosed in company's development in Five Bears mine, near Genesee, formerly owned by G. H. Goodhue.

San Bernadino County

POTASH PLANT, being erected jointly by Pacific Coast Borax Co. and Solvay Process Co. near the former's patented land on Searles Lake, is to be ready for operation about Apr. 1. Capacity estimated at 1000 tons per month of KCl, 80% or higher in purity.

ENCINITAS COPPER CO. (Encinitas)—Will install a 50-ton Kohlberg & Kraut flotation equipment, following tests on company's chalcopyrite ore by Southwestern Engineering Co. of Los Angeles. C. A. A. McGee is president, and main offices are at 715 Timken Bldg., San Diego.

Trinity County

TRINITY STAR DREDGING CO. (Lewiston)—Contract for 200,000 ft. of lumber for construction of dredge to be installed on Paulsen ranch has been let to Patrick Ryan of Weaverville. Lumber will be cut on Rush Creek with mill formerly operated by Valdor Dredging Co. W. B. Winston of San Francisco is president.

COLORADO

Boulder County

LIVINGSTON (Sugar Loaf)—On 500-ft. level, 4-ft. vein of payable milling ore opened.

NIL DESPERANDUM (Sunshine)—Active development disclosing payable ore. M. S. Brandt, manager.

APRIL FOOL (Sugar Loaf)—Being developed under lease by H. C. Smiley. Payable ore opened east of main shaft.

DELINEATOR (Ferberite)—Body of high-grade ferberite ore opened by recent development. Duncan mill in operation.

NANCY (Wallstreet)—Griswold Bros. & Hammond, operating under lease, opened shoot of smelting ore on Last Chance vein.

YELLOW PINE (Boulder)—Development being continued by Wallace & McHaig, lessees. Regular shipments of payable silver ore maintained.

HERALD (Sugar Loaf)—Shaft sunk an additional 200 ft. during last few months and levels advanced in payable ore. Shipments being made to custom cyanide plant of United States Gold Corporation.

SUMMIT (Wallstreet)—Leased to Charles Sullivan and associates. Air compressor installed and extensive development planned. A small streak of smelting ore opened for 50 ft.; drift will be advanced 100 ft. and a 100-ft. shaft will be sunk.

MOJAVE-BOULDER TUNGSTEN (Boulder Falls)—New mining plant recently destroyed by fire is being rebuilt. Loss estimated at $12,000. Extensive development performed during winter and considerable high-grade ore opened. N. H. Brown, manager.

COLUMBIA (Ward)—Four-ounce gold ore, carrying small amounts of silver and copper, opened by C. E. Bradenburg; the pocket of richest ore was found in shaft at 35 ft. Oreshoot is about 600 ft. long; vein averages about 2 ft. wide and assays of 0.5 to 1.0 oz. gold are frequent.

BOULDER TUNGSTEN PRODUCTION CO. (Boulder)—Breaking ground for refining plant on the Denver Boulder & Western tracks near mouth of Boulder Cañon. Buildings will include furnace plant, 36 x 99 ft.; acid plant, 36 x 90 ft.; laboratory and office. Machinery expected in April. Plant may be ready for operation in 90 days. Ferro-tungsten and tungstic acid will be produced.

Clear Creek County

BIG INDIAN (Georgetown)—Payable ore opened by lessees.

SANTIAGO (Georgetown)—Arrangements made to reopen this property under management of L. Jones.

ARGO MILL (Idaho Springs)—This plant treated 2700 tons of custom ore in February. R. E. Schirmer, manager.

LORD BYRON (Idaho Springs)—Being reopened by Charles Hixson and associates. Shaft being retimbered.

DRUID (Idaho Springs)—New compressor plant and machine drills have been installed. George E. Collins in charge.

LONE TREE (Freeland)—This property in Freeland gulch will be reopened under direction of E. M. Moscript.

SHAFTER (Idaho Springs)—Development started on the property through Big Five tunnel by C. O. Withrow.

CONCRETE (Idaho Springs)—Leased to Fremont Leasing Co.; development now in progress in drift from winze 100 ft. below tunnel level.

MATRIX MINING CO. (Lawson)—New incorporation, with capital of $30,000, by B. L. Wilson, J. D. Parker, and Oscar Anderson. Leasing on Prince Albert property near Lawson.

GRAND CLEAR CREEK (Empire)—Being developed under management of H. E. Willey. Zinc-lead ore being shipped to Newton mill at Idaho Springs for treatment.

SUN-MOON LEASING CO. (Idaho Springs)—New incorporation with 10,000 shares, par value of $1, organized by I. C. Clapper, G. L. Nye, and J. C. Hershey. Has commenced operations at old Sun and Moon mine, cleaning out workings preparatory to development.

Teller County

ROOSEVELT DRAINAGE TUNNEL is being pushed forward at rate of 7 ft. per day with one shift; the breast is near the east end line of the Comstock claim.

ISABELLA MINES CO. (Victor)—General Manager C. G. Mitchell has reported to directors the cutting of the Buena Vista vein at 183 ft. from winze, 16th level; vein still oxidized; samples high both in gold and silver.

IDAHO

Shoshone County

DOUGLAS (Beeler)—Having developed a large body of zinc-lead ore on three tunnel levels, the Anaconda company, which operates property under bond, has unwatered shaft sunk 150 ft. from the lower tunnel by former operators. In cutting station a 5- to 6-ft. vein of zinc ore was disclosed. Hauling 50 tons per day 10 miles to railroad for shipment to Montana.

NABOB (Kellogg)—Stockholders will meet on Mar. 31 to accept or reject proposition from Stewart Mining Co. to take over property, together with the Denver and Mascot claims, held under bond. Nabob stockholders to receive 750,000 shares in new company in exchange for old holdings. Also Stewart company to advance $65,000 to take up bond on Denver and Mascot, and place $150,000 in cash and 1,650,000 shares in treasury of new company to be used in building mill, tramway and otherwise equip property. New organization to be called Nabob Consolidated company, with capital stock of $3,500,000, shares par value $1. Large body of zinc-lead ore developed in Denver claim. Property on Pine Creek.

MICHIGAN

Copper

MICHIGAN (Rockland)—Enlarging of shaft for three compartments about half done; will be finished in about six weeks.

NEW ARCADIAN (Houghton)—Drifted 60 ft. each way on the 1500-ft. level. New rockhouse engine will be in commission soon.

TAMARACK (Calumet)—Minority stockholders voted Mar. 16 to accept Calumet & Hecla's offer of $60 per share for stock not already held by C. & H. company, which will continue management.

NEW BALTIC (Houghton)—Installing hoist taken out of No. 1 shaft of the New Arcadian; used only a year and is good for 1000-ft. depth.

NORTH LAKE (Lake Mine)—Drifted for 160 ft. on the unidentified lode with fair average showing. No other work being done except by the drill in the crosscut beyond the lode to get geological data.

VICTORIA (Victoria)—Company has cut loading station at the 27th level and has thus far run through 14 ft. of good copper ore without encountering the trap on either the hanging- or foot-wall side. Other levels also showing good grades.

SOUTH LAKE (Houghton)—Hoisting interrupted by breakdown of electric pump on the sixth level and the necessity of keeping bailing tanks going in order to prevent the pump from being flooded; company had been hoisting about 200 tons daily.

CALUMET & HECLA (Calumet)—Shipping an average of about 10,300 tons daily to mill; an excellent average for winter months. February production of C. & H. and its subsidiaries was as follows: C. & H., 6,230,533 lb.; Ahmeek, 2,261,356; Allouez, 742,250; Centennial, 151,759; Isle Royale, 1,141,888; La Salle, 173,511; Osceola, 1,495,058; Superior, 185,888; Tamarack, 529,315; White Pine, 250,449 lb.

MINNESOTA

Cuyuna Range

MINEAPOLIS CUYUNA MINING CO (Minneapolis, Minn.)—Sinking test shaft in Sec. 23, 47-29.

McKENZIE (Ironton)—Shaft in this mine on E ½, SE ¼, Sec. 28, 47-29, is through overburden and 25 ft. in the rock. Permanent buildings being erected and "Soo" line is building spur track to mine. Drill explorations have "proven" manganiferous orebody.

BARROWS (Barrows)—Valley Ore Corporation, of Duluth, is unwatering this mine in Sec. 10, 44-31. A Layne & Bowler four-stage pump installed; capacity 4500 gal. per min. Mine, formerly operated by Virginia Ore Co., has been idle for three years. C. T. Watson, of Crosby, is in charge.

MISSOURI

Joplin District

MILLER & STEPHENS (Tulsa, Okla.)—Shipped standard deep drill outfit to Hallowell, Kan., in Cherokee County, and will put down test hole for oil and gas.

BOOMERANG (Tar River, Okla.)—This 40-acre lease, sold by T. L. Robinson and sons to Dr. Skelton, Muskogee, Okla., Frank Childress, Galena, Kan., and W. H. Weir, Kansas City, Mo. Consideration, $65,000.

KITTY (Tar River, Okla.)—New mill nearly ready on 20-acre lease west of camp; capacity 300 tons per shift; steam power. Mining at 237 to 280 ft. Owned by Johnstown, Penn., men, and R. L. Kidner, of Kansas City, Mo.

ORONOGO CIRCLE (Oronogo)—Construction has begun on new 2000-ton mill, which is to be district's largest. Original plan included slime department with 40 tables, but will install Akins classifier and reduce number of tables to 16. Steam shovel to be used in opencut mining now at work excavating for railroad track to carry away waste. Expect to build mill in five months.

PICHER LEAD (Joplin)—After several months of curtailed operations, company began on Mar. 15 operating its four concentrating plants at Picher, Okla., 20 hours daily. Making more than 100 tons of concentrates daily from the four plants. Ball mill tried out at the Netta, largest of the Picher plants, has been taken out of the slime department on account of not having enough material to keep it busy; will be used later on. Four new shafts being put down by the company and one new concentrating plant being erected.

MONTANA

Jefferson County

MONTANA ZINC CO. (Corbin)—Developing its newly acquired tract of 100 acres about a mile from Corbin on Great Northern Ry. Vein being developed is over 3 ft. wide carrying copper, silver, lead and zinc. Zinc content from 20 to 40% per ton.

Madison County

VIRGINIA CITY DISTRICT becoming active. Reported that group of Virginia City men have leased Easton mine, south of city, and will start a cyanide plant in near future; mine was large producer in past. At Shafter mine three shifts are taking out ore and doing development work; mill will resume operations this spring.

Silver Bow County

NORTH BUTTE (Butte)—February copper production estimated at 2,800,000 lb.

DAVIS-DALY (Butte)—Estimated results for February indicate profits of nearly $50,000; gross receipts over $90,000 and expenses about $40,000. Output averages about 200 tons zinc ore and 400 tons copper ore.

BUTTE-DETROIT (Butte)—The remodeled mill at the Ophir is now operating at a profit in treating Davis-Daly ores from the Colorado mine, which run 15% zinc, the concentrates averaging 52% zinc and 16 oz. in silver. Profits from the

mill pay for a large portion of the development of the Ophir mine, reducing company's operating expenses to about $4000 per month. The Ophir expected soon to furnish additional zinc ore for the mill.

ANACONDA (Butte)—Minnie Healy fire, which spread into the West Colusa and Tramway mines and also caused the Leonard mine output to be slightly curtailed, is again under control, and nearly 1000 men who were out of work for a few days have gone back. The output, reduced by about 2000 tons a day on account of the shutdown, will return to normal soon. The case of Peter Geddes and others vs. Anaconda company to prevent acquisition of the Alice by exchange of stock was argued Mar. 12 before the court of appeals at San Francisco, which took the issue under advisement. Mar. 14 is the date set for payment by Anaconda of its installment on option on the Douglas mine in Cœur d'Alene district, Idaho; whether company will exercise option at this time has not been announced but from extensive improvements made it is assumed company will at least continue operations during term of lease of two years

NEVADA

Clark County

POTOSI (Arden)—Shipments of zinc-carbonate ore being made at rate of about 1200 tons per month; hauled by motor trucks to Arden. All shipments given preliminary treatment in company"s calcining plant, resulting in increased grade and decreased freight costs. Owned by the Empire Zinc Co.; made net profit of over $365,000 in 1916.

Nye County

TONOPAH ORE PRODUCTION for week ended Mar. 10 was 9318 tons valued at $167,724, comparing with 9685 tons for the previous week. Producers were Tonopah Belmont, 3015 tons; Tonopah Mining, 1900; Tonopah Extension, 2380; Jim Butler, 750; West End, 589; Rescue, 191; Halifax, 198; Montana, 145; Midway, 8; MacNamara, 142 tons.

UNION AMALGAMATED (Manhattan)—Work resumed at this property embracing about 78 acres on Litigation Hill. The 10-stamp mill may be moved to mouth of shaft.

CASH BOY CONSOLIDATED (Tonopah)—Drifting on orebody disclosed in winze, 1450-ft. level, continuing to give satisfactory results and suggests considerable extension of ore-bearing area in western section of district. R. A. Dooley, superintendent.

Storey County

ANDES (Virginia)—Saved 60 cars of ore averaging $5.10 per ton.

UNITED COMSTOCK PUMPING ASSOCIATION (Virginia)—Repairing station at Mexican-Ophir winze.

JACKET-CROWN POINT-BELCHER (Gold Hill) Alterations in mill; ore extraction from Jacket Tunnel workings.

MEXICAN (Virginia)—Installed electric cable to 2700-2900 winze and continued work on 2300 level.

CON. VIRGINIA (Virgina)—Showing continues favorable on 2700 level; assays for week range $1.32 to $20.94 per ton.

UNION (Virginia)—Extracted ore from 2500 and 2600 levels; three tons from 2600 sampled $332.76 per ton. Shipments to mill include 537 tons sampling $17.64.

NEW MEXICO

Grant County

MAUD S. (Mogollon)—This old producer recently bonded by the Oaks Co. which is cleaning out workings preparatory to active development.

MOGOLLON MINES CO. (Mogollon)—Continuing work on its tailings flume down Silver Creek; terminus is about 3 miles below at impounding dams on Mineral Creek.

SOCORRO (Mogollon)—At its Johnson mine, shaft is down 400 ft. with ore practically all the way; stations cut at each 100 ft. Hand drilling will be superseded by machines as soon as compressor installation is completed. Gasoline hoist used.

SOUTH DAKOTA

Lawrence County

CUSTER PEAK (Roubaix)—Shaft now 325 ft. deep and lateral work is being done. Most of machinery for concentrator is on the ground and as soon as weather permits, plant will be erected.

HOMESTAKE (Lead)—Installation of new hoist at B & M shaft completed and as soon as some minor changes are made, ore will be removed from mine by six-ton skips. Ellison station at 2000-ft. level is nearly finished and the shaft will be continued several hundred feet in depth.

Meade County

DAKOTA PLASTER (Black Hawk)—New fireproof plaster mill under construction.

OLD MIKE (Custer)—Compressor plant is being moved to Harr & Foye ground, near Pringle; regular shipments of mica will be made to Chicago commencing about Nov. 1.

CUYAHOGA (Custer)—Two new boilers added to equipment at this pyrite mine. One trial carload shipped and it is understood that year's output has been contracted.

Pennington County

HOMELODE (Silver City)—Ore is being blocked at 200-ft. level. Machinery for new mill has arrived.

NEW GOLDEN WEST (Rochford)—Development continues with satisfactory results. Expect to sink several hundred feet.

HILL CITY PRODUCERS (Hill City)—Plant in operation on tin ore from the Cowboy and adjoining leases. Tungsten ores will also be concentrated.

UTAH

Juab County

TINTIC SHIPMENTS for week ended Mar. 9, were 219 cars. There were 22 shippers.

SIOUX CONSOLIDATED (Eureka)—Drifting on both 800 and 1000 level to find continuation of copper orebody in Iron Blossom.

TINTIC STANDARD (Eureka)—Five cars shipped week ended Mar. 9. Total for February, 19 cars, in spite of adverse shipping and operating conditions brought about by bad weather.

EUREKA MINES (Eureka)—Good body of ore of shipping grade, carrying silver, lead and copper, opened below 1200 level as result of recent development. Lessees have mined much high-grade ore from upper levels. Shipments on company account to be started in immediate future. Jackson McChrystal, manager.

Salt Lake County

SOUTH HECLA (Alta)—New raise being driven from Dwyer Tunnel level, following fissure; about 1400 ft. from portal and 400 ft. from surface; some ore showing. Shipments lately restricted by heavy snows.

SELLS (Alta)—Ore being mined from development at 890 ft. below surface. Thought to extend upward, from evidence of old surface workings. Not yet extensively prospected. Shipments being made.

UTAH ORE SAMPLING (Salt Lake)—Company, on Mar. 12, reported release of 16 cars: Nine from Utah; four from Nevada; two from Idaho; and one from California. Company has sampling mills in operation at Murray, Silver City, and Park City.

AMERICAN CONSOLIDATED (Salt Lake)—This property in Big Cottonwood will install Pelton wheel, blower, and fan to take care of gas encountered in cross fissure intersecting Silver King fissure at depth of 500 to 600 ft. from surface. Some good ore found along Silver King fissure in 400 ft. of drifting.

Summit County

PARK CITY SHIPMENTS for week ended Mar. 9, were 3,177,460 lb. of ore and concentrates.

BIG FOUR EXPLORATION (Park City)—Blowers, shipped from Connersville, Ind., Feb. 16, held up en route, and starting of mill postponed. Hope to start mill by April.

CALIFORNIA-COMSTOCK (Park City)—Preparations being made for beginning active development. Ore of good grade being mined on 250 level. J. C. Jensen, manager.

DALY WEST (Park City)—Mill not in operation owing to frozen water supply. February shipments 410 tons and January, 864 tons. To be increased as soon as mill can again be operated. A good tonnage of milling ore is being developed, and mined from the 2100 level up to the 1400.

JUDGE MINING AND SMELTING (Park City)—Regular quarterly dividend of 25c. a share or $120,000 declared, payable Apr. 1, bringing total to $1,710,000. Production for 1916 was 19,437 tons of ore and concentrates. In January shipped 1210 tons of first-class ore, and in February 1044 tons. Second-class zinc concentrates stored for treatment in new electrolytic zinc plant.

Tooele County

DEEP CREEK RAILROAD, on Mar. 12, sent out its first train of ore from Goodwin; and effective transportation of ores from this district so long cut off from the market by long and expensive wagon-haul is now an accomplished fact. First shipment was from Western Utah Copper Co., of which Duncan MacVichie of Salt Lake is president, besides being president of the railway company. The Western Utah Copper Co. expects to make regular shipments of 5% copper ore from reserves it has developed. Freight alone will be handled for the present, but it is expected to have regular passenger service in force before end of April. Other mines in the district now producing ore are the Pole Star, Christmas group, Alvarado, Frankie, Copperopolis, etc.

Utah County

MILLER HILL (American Fork)—Development fund of this company increased by $20,000 from purchase of stock by leading stockholders. Controlled by Knight interests.

MINERAL FLAT (American Fork)—Contract let to drive 2100-ft. tunnel, 300 to 500 ft. further. Machine drills to be used. Company has 22 claims at head of American Fork Cañon and extending to top of ridge, which divides American Fork and Little Cottonwood districts. Jesse Knight, president; J. C. Jensen, general manager.

WASHINGTON

Ferry County

LONE PINE-SURPRISE CONSOLIDATED (Republ'.)—Shaft in Last Chance mine passed through 6-ft. orebody near 500-ft. point; station will be cut at 500-ft. level and shaft continued 30 ft. to provide sump. Skip ordered. G. C. Taylor, superintendent.

Stevens County

ELECTRIC POINT (Northport)—Another strike of lead-silver ore is reported from tunnel level, giving backs of 240 ft.; believed to be another chimney similar to several previously discovered, ranging from 25 to 36 ft. in size.

CANADA

British Columbia

HIGHLAND VALLEY (Ashcroft)—A. F. Bennett, a mining engineer from Duluth, has been making an inspection of this property with Frederic Keffer, general manager, with a view to greater development and an increased output.

GRANBY CONSOLIDATED (Victoria)—February production amounted to about 2,580,000 lb. as compared with 2,946,476 lb. in January; decrease of 366,000 lb., mainly due to bad weather at Anyox and coke shortage at Grand Forks; Anyox output off about 350,000 lb. Anyox production, 1,619,000; Grand Forks 1,071,000 lb.

LADYSMITH SMELTING CORPORATION (Ladysmith)—Remodeled plant of Tyee Copper Co. is about ready to resume operations. Converter will be installed. New owners who include Col. W. L. Stevenson, of Victoria, have secured properties that will furnish regular supplies of ore, and the smeltery will also handle custom ores. Great stimulus to mining industry on Vancouver Island is expected.

Ontario

ORE SHIPMENTS FROM COBALT for February over the Temiskaming & Northern Ontario Ry. are reported by Arthur A. Cole, mining engineer, as follows: Beaver, 39.63 tons; Buffalo, 32.30; Cobalt Comet—Dom. Red. Co.—41.20; Coniagas, 101.30; Crown Reserve—Dom. Red. Co.—67.79; Hudson Bay, 30.77; Kerr Lake—Dom. Red. Co.—69.60; La Rose, 87.40; Mining Corporation of Canada, 38.81; McKinley-Darragh, 111.22; O'Brien, 32.86; Penn Canadian, 38.15; Temiskaming, 28.90; Trethewey, 36.71; total for Cobalt proper, 756.64 tons; Miller Lake-O'Brien (Elk Lake) 25; total silver-ore shipments, 781.64 tons. Alexo (Porquis Jct.), 322 tons of nickel ore; Slade & Forbes Asbestos Co. (South Porcupine), 1 ton of asbestos fiber.

TASH-ORNE (Tashota)—Shaft now down to 100-ft. level; vein, comparatively narrow at surface, has widened to width of shaft.

KERR LAKE (Cobalt)—Silver production in February amounted to 206,474 oz. as compared with 215,206 oz. in January

JUPITER—Diamond drill, operating on east end of property, cut 5-ft. vein high-grade ore at 735 ft. from the surface. Shaft being sunk from 500 ft. to 1000 ft.

CORDOVA (Cordova)—Fire on Mar. 13 destroyed large part of surface equipment of this gold mine, causing loss of $100,000; covered by insurance.

McINTYRE (Schumacher)—During February gross production was $143,802 from 13,500 tons; average value $10.65 per ton. Mill now doing 600 tons per day; down two days during month for installation of new hoisting system.

BOSTON CREEK (Boston Creek)—Winze from 200-ft. level has reached the 300. Camp buildings being constructed so as to increase the force from about 50 to 90 or 100 men. Power may be secured from the Cobalt-Kirkland Lake line.

TOUGH OAKES (Kirkland Lake)—Annual report for 1916 shows earnings from production $707,114; net profit, $260,668. After payment of dividend amounting to $265,750 and other deductions there was deficit of $104,667. Mine development much curtailed owing to insufficient power.

Quebec

BLACK LAKE ASBESTOS AND CHROME CO. (Black Lake)—At the annual meeting in Montreal, Robert F. Massie, managing director, said that drilling had shown a reserve of asbestos that would last for 15 years, adjoining the present workings. Company's product, which is medium grade, is in demand at $90 per ton, price before the war being $45 per ton. Annual report showed income of $77,788; expenses, $14,133; net profits, $63,654.

MEXICO

SANTA GERTRUDIS (Pachuca, Hildalgo)—General manager reports for quarter ended Dec. 31, 1916: Estimated profits from 33,243 tons about $16,200. Development amounted to 2467 ft., of which 981 ft. were in payable ore, 718 ft. in unpayable vein matter and 768 ft. in country rock. Average milling rate for period was 33% capacity, due to shortage of cyanide. Milling operations completely suspended for 36 days and carried on at a reduced rate during remainder of period. All work not immediately necessary suspended pending improvement in cyanide delivery. Increased cost of living making itself felt in gradually increasing wage schedule; present scale fully 25% higher than that of 1912, which it has been customary to take as normal.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

Mar.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Mar.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
15	4.7544	73	35⅞	19	4.7550	72⅞	36 3/16
16	4.7550	73	35¾	20	4.7553	72⅞	35 15/16
17	4.7550	73	35 11/16	21	4.7553	72⅞	35⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Mar.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	31		9	9	9⅜
15	@32	53	@9½	@9¾	@10⅛
	31		9	9	9⅜
16	@32	53½	@9½	@9¾	@10⅛
	31		9	8¾	9⅜
17	@32	54	@9½	@9¾	@10⅛
	30½		9	8¾	9⅜
19	@32	54½	@9½	@9¾	@10⅛
	30½		9	8¾	9⅜
20	@32	56	@9¼	@9½	@10⅛
	30½		9	8¾	9⅜
21	@32	56	@9¼	@9⅜	@10⅛

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes; ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Mar.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
15	136	135½	151	203¾	203	30½	47
16	136	135½	151	205	204½	30½	47
17	....	....	....	....	....	....	....
19	136	135½	151	208¾	208½	30½	47
20	136	135½	151	214	213	30½	47
21	136	135½	151	211	210½	30½	47

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅞c.

NEW YORK—Mar. 21

Throughout the last week the markets for copper, lead and zinc were dull and irregular, but easier in tone. Tin was the only metal exhibiting strength during the week.

Copper, Tin, Lead and Zinc

Copper—Transactions were very light, more so than in the previous week, which in turn were less than in the week preceding. Copper for April-June delivery is wanted, but cannot be supplied to any satisfactory extent. The scarcity has been increased by the strike at the Nichols refinery, while other large producers are behindhand in their deliveries. These conditions have caused several manufacturers to close their plants, a serious thing owing to danger of disorganization of their working forces. While copper this side of the mid-year is so scarce, manufacturers generally are averse to buying for later delivery. Solicitation of all of the principal consumers last week failed to develop business for third-quarter delivery, although concessions in price were offered. Such business as was done for third-quarter and second-half was by manufacturers covering business already entered on their books, but those cases are sporadic, manufacturers in general reporting but little business booked after July 1.

In view of these conditions, the market, considered broadly, is highly irregular, prices varying widely according to the date of delivery contracted. Thus, on Mar. 21 a round lot for delivery in the last quarter of the year was booked at 29¾c., cash, while July delivery was done at 32c. Third-quarter was offered at 30½c., r.t. Near-by copper was easier than in the previous week, being offered at 34½c., with indications that it could be secured for less. Indeed, speaking generally, the copper market was easier during the last week.

The announcement on Mar. 21 that copper producers had agreed to furnish the U. S. Government with about 50 million pounds of copper at 16⅞c. for deliveries extending 12 months from Apr. 1, excited a good deal of conjecture and uncertainty. Some manufacturers expressed the opinion that if the producers would sell for that price to the Government they ought to do so to them. In fact, the price made by the producers had no relation whatever to market conditions, but was simply an exhibition of patriotism. Many persons have volunteered to put their plants, services, etc. at the disposal of the Government, but no one except Mr. Ford had said specifically what he would do. The copper producers were of the opinion that actions would speak louder than words, and made, therefore, what is practically a gift to the nation.

The strike at the Nichols refinery continues unsettled. Some of the men have returned to work and at least one of the wire-bar furnaces has been put in operation, but as yet the plant is no more than half manned.

Copper Sheets—No change has been reported in the situation as described last week. We continue to quote hot rolled at 42@44c. per lb., cold rolled 1c. per lb. higher. Wire still quoted at 37c. per lb., f.o.b. mill.

Tin—In view of the continued scarcity of supplies, and the uncertainty of the immediate future, a relatively small demand was sufficient to advance the price sharply.

Lead—Transactions were less in volume than in the previous week. The major part of the business was done in a few large lots, and was chiefly for April and April-May shipment. All of this business was done at 9c. Lead for March shipment was still held stiffly, but the demand for it was relatively small and transactions light. At the close, March shipment was easily to be had at 9⅜c., New York, and 9¼c., St. Louis. However, as previously stated, the bulk of the business of the week was done at 9c.

Zinc—This metal was also very dull. The business reported was chiefly for second-quarter delivery, and was done at about 9¾c. April shipment was to be had at about 10c., and March at 10¼c.

Zinc Sheets—Price of zinc sheets has not been changed. Market remains at $21 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—The aluminum market continues quiet and no change is reported from last week's conditions. Nominal quotation is 58@60c. per lb. for No. 1 ingots, New York.

Antimony—Spot is very scarce and transactions were only in small lots; one small quantity reported changed hands at 37c. We quote 33@34c. February shipments from China quoted at 17½@18c. and March-April shipments 14@15c., c.i.f., New York, duty unpaid.

Nickel—The market remains steady at 50@55c. per lb. for nickel. Electrolytic commands an additional 5c. per lb.

Quicksilver—Fair demand, stocks small, we quote $115@120. San Francisco reports, by telegraph, $115 firm.

Gold, Silver and Platinum

Gold—Under date of Mar. 1, 1917, Samuel Montagu & Co., London, report: It is announced that the Indian government has offered, and His Majesty's government has gratefully accepted, a contribution of £100,000,000 toward the general cost of the war. Part of this amount will be raised by loan in India, and the remainder will be represented by the Indian government's assumption of liability for interest upon such amount of the National War Loan as may be needed to complete the capital sum of £100,000,000. This arrangement may prove of assistance in relieving some of the difficulties that have attached lately to the Indian Exchange and also may afford some relief with regard to the demand in India for metallic currency, though this may not be felt for some time.

Arrangements have been entered into between A. Iselin & Co. and representatives of the "de facto" government of Mexico whereby the former will undertake to have gold pesos coined in this county. These will be legal currency in Mexico. Mexican government authorized coinage of 20,000,000 gold pesos a short time ago, and the arrangement for coining here is the result of that decree. Arrangements are said to have been made to have the work done at the Philadelphia mint.

Silver—Silver market the past week has ruled fairly steady advancing from 35⅞ pence to 36⅜ and reacting again to 35⅞. The lower price for silver has been due to sales, by China and India and light London demand. There has been a practical prohibition of exports from London to the East. The upheaval in Russia has also affected the demand, as Japan has been minting silver coins for Russia, but Russian demand should continue as soon as the new government is stabilized. The stock in London is now about 5,000,000 oz. Market closes steady with light business in London.

It is said that 5000 bars of silver, 1000 oz. each, a total of 5,000,000 oz. went down with the "Laconia."

Mexican dollars at New York, Mar. 15, 56⅜@59⅜c.; 17, 56⅜@59⅜c.; 17, 56¾@59¾c.; 19, 56¾@59¾c.; 20, 56¼@59¼c.; 21, 55¾@58¾c.

Platinum—We quote the market unchanged at $102½@105.

Our Petrograd correspondent reports under date of Jan. 20, 1917, that the position is unchanged. The whole produced platinum is delivered to the State Bank. The Government has resolved to pay for the confiscated platinum $80.36 per oz. of crude platinum. From Ekaterinburg it is reported that the production of crude platinum in the year 1916 has considerably decreased. The yield of the principal platinum-producing companies has declined to a particularly great extent. If free platinum trade is allowed very high prices are expected.

Palladium—We quote $85@90.

Zinc and Lead Ore Markets

Platteville, Wis., Mar. 17—Blende, basis 60% Zn, $90 for premium ore down to $85 for medium grade. Lead ore, basis 80% Pb, $113 per ton. Shipments reported for the week are 1321 tons of zinc ore, 66 tons of lead ore, and 335 tons of sulphur ore. Report is incomplete due to interrupted telephone service. For the year to date the figures are: 27,822 tons of zinc ore, 876 tons of lead ore, and 4596 tons of lead ore. Shipped during week to separating plants, 2280 tons of zinc ore.

Joplin, Mo., Mar. 17—Blende, per ton, high $95.50; basis 60% Zn, premium ore $90; medium to low, $90@80. Calamine basis 40% Zn, $56@50. Average selling price all grades of zinc, $84.64.

Lead, per ton, high $125.75; basis, 80% Pb, $122.50@120. Average selling price all grades of lead, $118.78.

Shipments the week: blende 10,340, calamine 989, lead 1456 tons. Value, all ores the week, $1,137,640.

Very little buying was done after midweek, except subject to freight consignment, owing to the threatened strike of railway employes. Movements were speeded to the greatest possible extent with the heaviest shipment of the year resulting. While the strike is the center of conversation there is an optimistic feeling regarding the outcome. Effective, its evil would be far reaching and decisively disastrous.

Other Ores

Antimony Ore—This continues scarce, and is quoted at $2.30 per unit for shipment and at $2.60 per unit for spot delivery.

Molybdenite—The demand is no longer so pressing and prices are a little easier. We quote $1.80 per lb. of MoS_2.

Tungsten Ore—Business continued at $17 per unit for wolframite, and as high as $17.50 for scheelite.

Iron Trade Review

NEW YORK—Mar. 21

Prices are undeniably the main concern of the iron and steel trade, says "Iron Age." This week, like those preceding, marks further advances. Those already made have been fairly well tested and there is nothing discernible that is calculated to reduce them for many months unless it be a lack of balance in respect to the new capacity being completed from time to time.

International conditions have, if anything, stimulated demand. Foreign bidding for materials seems not to have diminished in any particular and many domestic consumers are eager to secure forward protection.

PITTSBURGH—Mar. 20

If there had been a general railroad strike the iron and steel industry would simply have slowed down in proportion to its extent. Scarcely any preparation was made last week against a strike as there was no way in which this could be done. Production and distribution is so difficult at this time that the feeling of relief to be expected at the strike being averted is not as apparent as might be assumed. The industry still has many troubles.

Transportation conditions continue to improve slowly. Pig iron and steel production is increasing slowly but at best it will be several weeks before the record rate can again be attained. Shipments are now slightly in excess of current production but it will be a long time before all the steel accumulated in recent months is moved.

Steel bookings are almost wholly of routine character, the covering of regular customers for additional tonnages, current bookings averaging more than three-fourths as large a tonnage as the shipments. In tubular goods bookings greatly exceed shipments. In the wire trade there is approximately an even break, while in bars, plates and shapes as a group the shipments are slightly in excess. In sheets and tin plates bookings are very light as mills have not opened their books for second-half contracts. This event may occur early next month. In sheets the booking will be under the new contract form, providing for the full carrying out of contracts and assessing damages against either buyer or seller in case he does not live up to the contract.

The tonnage of rush orders in connection with Government work is already important, and operates to delay deliveries on orders already placed by ordinary domestic consumers. Deliveries on Government steel, made and shortly to be made, are probably heavier than are actually needed, the steel producers merely acceding to all legitimate requests that are made.

Pig Iron—Bessemer at $36, valley, has disappeared, even for late delivery and the market is at least $1 a ton higher, while basic iron quotations run up to $35 and the market may soon be on that level. Consumers of valley iron are commonly in mood to cover for third quarter but not for fourth. Virginia and southern Ohio furnaces are sold up for the year and are effecting some sales for the first half of 1918. Alabama furnaces are also reported sold up for this year. The market is in sellers' hands while buyers show a wide divergence of views as to what they should do. The market stands approximately as follows: Bessemer, $37@38; basic, $32@35; foundry and malleable, prompt, $36@38; second half, $35@36, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Ferroalloys

Ferromanganese—Occasional sales of prompt have been made at above $300, but in general the market is quotable at $275@300 for prompt and second quarter, $275 for third and $250 for fourth quarter, domestic, delivered. The quotation of $185 on imported is almost entirely withdrawn.

Ferrotungsten—Several large orders were placed.

Ferrosilicon—The 50% material is quoted at $250. Bessemer, 10%, $42.

Spiegeleisen—Spot and contract quoted at $75@80.

Coke

Connellsville—The prompt market is easier, car supplies this week being the largest for weeks, although not fully equal to requirements. Buyers show little interest in second half contracts and quotations are nominal. We quote: Spot furnace, $9@9.50; spot foundry, $11@12; second-half contracts: furnace, $7@8; foundry, $7.50@8.50, per net ton at ovens.

STOCK QUOTATIONS

N. Y. EXCH.†	Mar. 20
Alaska Gold M.	8⅛
Alaska Juneau	7
Am.Sm.&Ref.,com.	108⅛
Am. Sm. & Ref., pf.	113
Am. Sm. Sec., pf. A	100⅛
Am. Sm. Sec., pf. B	95⅛
Am. Zinc	37⅛
Am. Zinc, pf.	68⅛
Anaconda	86⅛
Batopilas Min.	1⅛
Bethlehem Steel	146
Bethlehem Steel, pf.	120
Butte & Superior	47⅛
Cerro de Pasco	39
Chile Cop.	25⅛
Chino	59⅛
Colo.Fuel & Iron	53⅛
Crucible Steel	71⅛
Dome Mines	18⅛
Federal M. & S.	18⅛
Federal M. & S., pf.	43
Great Nor., ore ctf.	37⅛
Greene Cananea	45⅞
Homestake	125
Inspiration Con.	63⅛
International Nickel	46⅛
Kennecott	46⅛
Lackawanna Steel	86⅛
Miami Copper	41⅞
Nat'l Lead, com.	57⅞
National Lead, pf.	111⅛
Nev. Consol.	24⅛
Ontario Min.	5⅛
Quicksilver	2
Quicksilver, pf.	2⅛
Ray Con.	29⅛
Republic I.&S.,com.	85⅛
Republic I. & S. pf.	102⅛
Sloss-Sheffield	73
Tennessee C. & C.	17
U. S. Steel, com.	117
U. S. Steel, pf.	118⅛
Utah Copper	115⅞
Va. Iron C. & C.	67

N. Y. CURB†	Mar. 20
Buffalo Mines	1.15
Butte & N. Y.	2
Butte C. & Z.	11⅛
Caledonia	.63
Calumet & Jerome	1⅛
Can. Cop. Corpn.	1⅛
Carlisle	5⅛
Con. Ariz. Sm.	2⅛
Con. Coppermines	4⅛
Con. Nev.-Utah	2⅛
First Nat. Cop.	2⅛
Goldfield Con.	.58
Goldfield Merger	.07⅛
Granite	‡.25
Greenmonster	2
Hecla Min.	8
Howe Sound	6⅞
Jerome Verde	2
Joplin Ore & Spel.	.30
Kerr Lake	4⅛
Magma	47⅛
Majestic	1/16
McKinley-Dar-Sa.	.49
Mother Lode	.40
N. Y. & Hond.	14
Nipissing Mines	8
Ohio Cop.	1 1/16
Ray Hercules	4
Rochester Mines	.50
St. Joseph Lead	18⅛
Seneca	13⅛
Standard S. L.	1⅛
Stewart	.46⅞
Success	.47
Tonopah	6⅛
Tonopah Ex.	3⅛
Tribullion	1/16
Troy Arizona	.62
United Verde Ext.	39⅛
United Zinc	.5⅛
White Knob, pf.	1⅛
White Oaks	2
Yukon Gold	1⅞

SAN FRAN.*	Mar. 20
Alta	.03
Andes	.12
Best & Belcher	.04
Bullion	.01
Caledonia	.14
Challenge Con.	.05
Confidence	.10
Con. Virginia	.09
Gould & Curry	.01
Hale & Norcross	.04
Jacket-Cr. Pt.	.04
Mexican	.04
Occidental	‡.65
Ophir	.10
Overman	.04
Savage	.05
Seg Belcher	.02
Sierra Nevada	.10
Union Con.	.34
Utah Con.	.01
Belmont	4.25
Jim Butler	.70
MacNamara	.07
Midway	.15
Mont.-Tonopah	.21
North Star	.15
Rescue Eula	.27
West End Con.	.60
Atlanta	.13
Booth	.10
Comb. Frac.	.05
D'field B.B.	‡.02
D'field Daisy	.03
Florence	.20
Jumbo Extension	.40
Kewanas	.17
Round Mountain	.45
Silver Pick	.10
Argo	.05
Ariz. Central	.10
Big Jim	1.25
Lazy Boy	.06
Neilie	.18
Tom Reed	2.00
United Eastern	4.12½
United Western	‡.02

BOSTON EXCH.*	Mar. 20
Adventure	3⅛
Ahmeek	102½
Algomah	.93
Allouez	68⅞
Ariz. Com., ctfs.	13⅛
Bonanza	‡.30
Butte-Balaklava	1⅛
Calumet & Ariz.	83
Calumet & Hecla	565
Centennial	21⅛
Copper Range	65½
Daly West	2⅛
Davis-Daly	5⅛
East Butte	15
Franklin	8⅛
Granby	88
Hancock	18
Hedley	16
Helvetia	.50
Indiana	3⅛
Island Cr'k, com.	67⅛
Isle Royale	34
Keweenaw	3⅛
Lake	14⅛
La Salle	4
Mason Valley	6⅞
Mass	14⅛
Mayflower	2⅛
Michigan	4⅛
Mohawk	89
New Arcadian	4⅛
New Idria	16
North Butte	22⅛
North Lake	1⅛
Ojibway	2
Old Colony	2⅛
Old Dominion	64⅛
Osceola	95
Quincy	90
St. Mary's M. L.	86⅛
Santa Fe	1⅛
Shannon	9⅛
Shattuck-Ariz.	29
So. Lake	4⅛
So. Utah	.30
Superior	15
Superior & Bost.	6⅛
Tamarack	58
Trinity	4⅛
Tuolumne	1⅛
U. S. Smelting	64⅛
U. S. Smelt'g, pf.	51⅛
Utah Apex	6
Utah Con.	17⅛
Utah Metal	6
Victoria	5⅛
Winona	5
Wolverine	46⅛
Wyandot	1⅛

BOSTON CURB*	Mar. 20
Alaska Mines Corp.	1⅛
Bingham Mines	.10⅛
Boston Ely	.56
Boston & Mont.	.67
Butte & Lon'n Dev.	.22
Calaveras	4
Calumet-Corbin	.02
Chief Con.	2⅛
Cortez	.15
Crown Reserve	.34
Crystal Cop.	.85
Eagle & Blue Bell	2⅛
Houghton Copper	1⅛
Intermountain	1⅛
Iron Cap Cop., pf.	15⅛
Mexican Metals	.18
Mines of America	1⅞
Mojave Tungsten	.55
Nat. Zinc & Lead	.53
Nevada-Douglas	2⅛
New Baltic	1⅛
New Cornelia	18
Oneco	.70
Pacific Mines	.25
Rex Cons.	.34

SALT LAKE*	Mar. 20
Big Four	.72
Black Jack	.06
Cardiff	4.50
Colorado Mining	.16
Crown Point	.04
Daly-Judge	8.60
Emma Con.	1.25
Empire Copper	1.50
Gold Chain	.15
Grand Central	.52
Iron Blossom	1.22½
Lower Mammoth	.03
May Day	.09⅛
Moscow	.12
Prince Con.	1.25
Seven Troughs	.02½
Silver-King Coal'n	3.10
Silver King Con.	4.10
Sioux Con.	.13
So. Hecla	1.37½
Uncle Sam	.04
Wilbert	.14
Yankee	.11⅛

TORONTO*	Mar. 20
Bailey	.06
Beaver Con.	.41
Chambers Ferland	.12
Conisgas	4.10
La Rose	.53
Peterson Lake	.12
Right of Way	.04
T. & Hudson Bay	55.00
Temiskaming	.52
Wettlaufer-Lor.	.06
Dome Exten.	.26
Dome Lake	.19
Foley O'Brien	.70
Hollinger	5.15
Jupiter	.31
McIntyre	1.85
Newray	1.12
Porcu. Crown	.62½
Schumacher	.63
Vipond	.43
West Dome	.28

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Mar. 20
Cresson Con.	6.00
Doctor Jack Pot	.07⅛
Elkton Con.	.10
El Paso	‡.40
Gold Sovereign	.04
Golden Cycle	2.35
Granite	.50
Isabella	.19⅛
Mary McKinney	.25
Portland	1.70
United Gold M.	.16⅛
Vindicator	.80

LONDON	Mar. 5		
Alaska Mexican	£0	12s	6d
Alaska Tre'dwell	2	10	0
Burma Corp.	3	17	6
Cam & Motor	0	9	6
Camp Bird	0	5	6
El Oro	0	7	6
Esperanza	0	8	3
Mexico Mines	4	10	0
Nechi, pfd.	0	12	6
Oroville	0	15	6
Santa Ger't'dis	0	8	9
Tomboy	1	0	0

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755	77.585	22.753	26.975	37.742
March	50.241	57.935		23.708	27.597	
April	50.250	64.415		23.709	30.662	
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.765		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440	31.750	102.667	137.895	133.167	148.100
Mar.	26.310		107.714		136.000	
April	27.895		124.319		137.389	
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185 13
February	42.717	51.420	181.107	198 74
March	50.741		193.609	
March	51.230		199.736	
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246	8.636	6.164	8.595	31.988	30.500
March	7.136		7.375		34.440	
April	7.630		7.655		34.368	
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420	10.045	18.260	9.875	97.762	47.000
Mar.	16.846		16.676		95.048	
April	16.695		16.525		99.056	
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ⅛ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16	36.37	18.93	30.95	19.51	30.95
March	21.81		19.20		19.45	
April	21.65		18.95		19.45	
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.